



United States Department of Agriculture
Forest Service

Sweet-Ione Integrated Resources Improvement Project

Newport-Sullivan Lake Ranger Districts

Colville National Forest

Aquatics Report

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1.0 Introduction

The USDA Forest Service, Colville National Forest (CNF) proposes to manage timber and other forest resources on National Forest System (NFS) lands in the Sweet-Ione Project Area. Proposed activities would include temporary road construction, timber harvest, post-harvest road closures and decommissioning, post-harvest fuels reduction, and habitat improvements. This document is an analysis of the potential effects of the Sweet-Ione Integrated Resources Improvement Project on aquatic resources based on direction found within the Colville National Forest Land Management Plan (Forest Plan) (USDA 2019).

1.1 Project Area Description

The Sweet-Ione project area covers approximately 20,586 acres within two United States Geological Survey (USGS) Hydrologic Unit Code¹ 12 (HUC12) subwatersheds: Big Muddy Creek and Sweet Creek (Table 1, Figure 1). Sweet Creek subwatershed encompasses a total of 41,832 acres comprised of two catchment areas located on opposite sides of the Pend Oreille River; however, it is not a true watershed because the catchment areas do not drain to a single, common outlet. The project area is located within the 25,525-acre portion of Sweet Creek subwatershed west of the Pend Oreille River, and this document is limited to this western portion of Sweet Creek subwatershed.

Table 1. USGS watersheds in the Sweet-Ione Project area

Basin (HUC 6)	Subbasin (HUC 8)	Watershed (HUC 10)	Subwatershed (HUC 12)	Subwatershed Area (acres)	Project Area (acres)	Project Area Percent of Subwatershed
Pend Oreille (170102)	Pend Oreille River (17010216)	Slate Creek – Pend Oreille River (1701021609)	Big Muddy Creek (170102160901)	17,661	12,275	70%
Pend Oreille (170102)	Pend Oreille River (17010216)	Slate Creek – Pend Oreille River (1701021609)	Sweet Creek (170102160902)	26,525	8,306	31%

¹ USGS delineates watershed boundaries at various scales (e.g., Basin, Subbasin, Watershed, Subwatershed) and each are identified by 2-digit codes for each scale known as Hydrologic Unit Code (HUC).

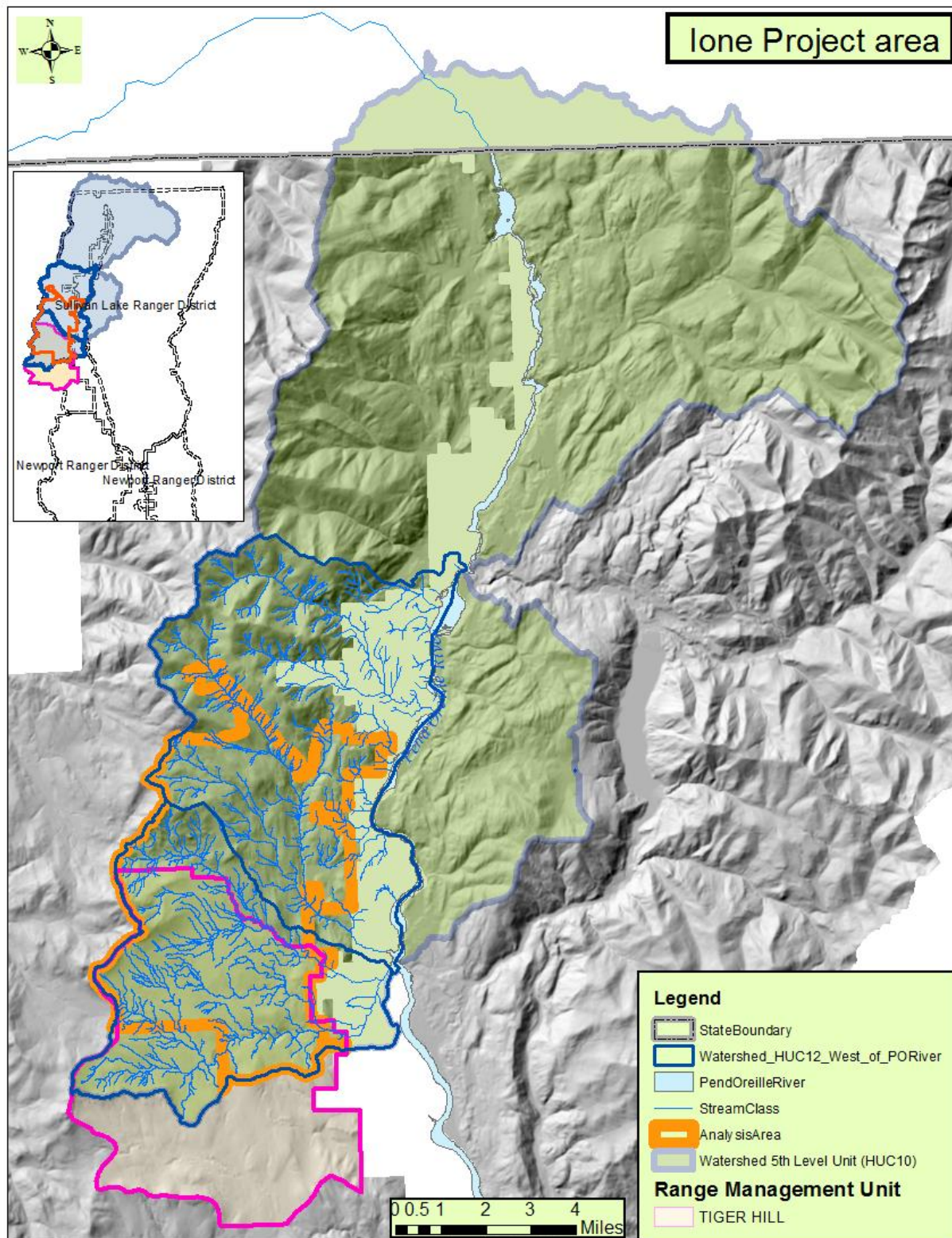


Figure 1. Location of Sweet-Ione project area and USGS HUC 12 subwatersheds.

1.2 Watershed Condition Framework

Forest Plan guideline FW-GDL-WR-01 directs the maintenance or improvement of watershed condition through the use of the Watershed Condition Framework (WCF) and associated WCF Technical Guide (USDA 2011). The WCF is a systematic assessment method to score and rate watershed condition at the as Functioning Properly (good condition); Functioning at Risk (fair condition); or Impaired Function (poor condition) through the assessment of aquatic and terrestrial physical and biological ecosystem processes that contribute to comprise watershed condition. The WCF assessment method is applied at the HUC 12 subwatershed scale using 12 indicators and 23 associated attributes that are scored and rated within each ecosystem process category (Table 2), and from which ecosystem process category scores are calculated and used to score and rate subwatershed condition.

Table 2. WCF ecosystem processes, indicators, and attributes

Indicator	Attribute	Attribute Measure	Source
Ecosystem Process: Aquatic Physical			
Water Quality	TMDL - Impaired water quality: Temperature, Bacteria	Washington State Water Quality Standards	Colville Land Management Plan (FW-DC-WR-05,10), Washington Department of Ecology 2016 EPA approved 305(b) report, Watershed Condition Framework (WCF)
Water Quality	Other: Sedimentation	Road Densities (mi/mi ²)	Colville Land Management Plan (FW-DC-WR-06), WCF
Water Quantity	Flow Characteristics	Acres treated, diversion count, diversion function (mimic natural hydrograph)	Colville Land Management Plan (FW-DC-WR-07), Grant et al. 2008, WCF
Aquatic Habitat	Habitat Fragmentation	Road/stream crossings, dams	Colville Land Management Plan (FW-DC-WR-02), WCF
Aquatic Habitat	Large Wood	Large wood count, pools, bank stability	Colville Land Management Plan (FW-DC-WR-04), WCF
Aquatic Habitat	Channel Shape and Function	Bankfull width, width-to-depth ratio, floodplain connectivity, bank erosion, vertical adjustment	Colville Land Management Plan (FW-DC-WR-04,06,08,09), WCF
Ecosystem Process: Terrestrial Physical			

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Indicator	Attribute	Attribute Measure	Source
Road/Trail Network	Open Road Density	mi/mi ²	Colville Land Management Plan (MA-DC-FR-05, MA-DC-GR-05, FW-DC-WR-17; MA-DC-RMA-04), WCF
Road/Trail Network	Road Maintenance	Percent properly maintained	Colville Land Management Plan (FW-GDL-WR-05), WCF
Road/Trail Network	Proximity to water	Riparian Management Area (RMA)road density (mi/mi ²), percent of roads in RMA	Colville Land Management Plan (FW-DC-WR-02,17; MA-DC-RMA-04), WCF
	Mass wasting	Road (mi) on unstable landforms	Colville Land Management Plan (FW-DC-WR-01,02), WCF
Soils	Soil Productivity	Qualitative analysis of acres compromised to maintain resource values and sustain outputs: limited, moderate, or high	Colville Land Management Plan (FW-DC-SOIL-01,02; FW-STD-SOIL-01), WCF
Soils	Soil Erosion	Qualitative analysis of acres with evidence of accelerated erosion: limited, moderate, or high	Colville Land Management Plan (FW-DC-SOIL-01,02; FW-STD-SOIL-01), WCF
Soils	Soil Contamination	Qualitative analysis of acres contaminated are zero, limited, or extensive	Colville Land Management Plan (FW-DC-SOIL-01), WCF
Ecosystem Process: Aquatic Biological			
Aquatic Biota	Life Form Presence	Distribution (% habitat occupied)	WCF, Colville Land Management Plan (FW-DC-WR-03), WCF
Aquatic Biota	Native Species	Distribution (% habitat occupied)	WCF, Colville Land Management Plan (FW-DC-WR-03, 13), WCF
Aquatic Biota	Exotic/Invasive Species	Distribution (% habitat occupied)	WCF, Colville Land Management Plan (FW-DC-WR-12), WCF
Riparian Vegetation	Vegetation Condition	Human Disturbance (ac)	WCF, Colville Land Management Plan (FW-DC-WR-11, MA-DC-RMA-01,02), WCF

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Indicator	Attribute	Attribute Measure	Source
Ecosystem Process: Terrestrial Biological			
Fire Regime	Fire Regime Condition Class	Percent acres in FRCC class I, II, and III	Colville Land Management Plan (FW-DC-VEG-11,13; FW-OBJ-VEG-02, WCF
Forest Cover	Loss of Forest Cover	Percent of deforested land managed by NFS	Colville Land Management Plan (FW-DC-VEG-03, FW-OBJ-VEG-01, FW-GDL-VEG-03), WCF
Rangeland Vegetation	Rangeland Vegetation Condition	Percent of vegetation utilized (ratio of average annual plant production to production potential). Tiger Hill Allotment is in Big Muddy subwatershed. No range allotment is in Sweet Creek subwatershed; therefore, not applicable or included in Sweet Creek subwatershed existing condition or effects tables.	Colville Land Management Plan (MA-DC-RMA-03, MA-GDL-RMA-12), WCF
Terrestrial Invasive Species	Extent/Rate of Spread	Qualitative analysis of acres with infestation of invasive species requiring management intervention to maintain risk level: few, moderate, or widespread	Colville Land Management Plan (MA-DC-RMA-03, MA-GDL-RMA-12), WCF
Forest Health	Insect and Disease	Percent acres of forested land at imminent risk of tree mortality	Colville Land Management Plan (FW-DC-IS-01, FW-OBJ-IS-01,02,03, FW-STD-IS-01, FW-GDL-IS-01,02,03), WCF
Forest Health	Ozone	The only known area of concern in Washington state is Maryhill, located on the lower Columbia River approximately 100 miles upstream of Portland, Oregon. It has been found ozone damage occurs downwind of high inputs of automobile exhaust, such as found in large cities (personal communication Karen Ripley, Forest Health Monitoring coordinator, PNW Research Station, July 2020)	Colville Land Management Plan (FW-DC-WR-14), WCF

1.3 Methodology

Field observations, survey data, and monitoring data; corporate data; relevant scientific literature; observations from similar past projects; and professional judgment were used to assess the existing condition and potential effects from the proposed project on watershed condition and aquatic resources.

Methodology and assumptions for fish habitat are based on data collected during the Forest's Level II stream habitat surveys. Forest Service field crews collected data on fish bearing streams on both NFS and

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non-NFS lands within the project area, and status and condition information at all stream crossings located on closed NFS roads within the project area.

The Washington State Department of Natural Resources (WADNR) forest practices database was queried to assess harvest and road-related cumulative effects within each subwatershed.

2.0 Existing Condition

2.1 WCF – Big Muddy Creek Subwatershed

Big Muddy Creek subwatershed is currently rated as Functioning at Risk (fair condition). Indicators for water quantity, soils, forest cover, and rangeland vegetation are currently rated as Functioning Properly (good condition). Indicators for aquatic habitat, riparian vegetation, fire regime, terrestrial invasive species, and forest health are currently rated as Functioning at Risk (fair condition). Indicators for water quality, road/trail condition, and aquatic biota are currently rated as Impaired Function (poor condition) (Table 3).

Table 3. WCF existing condition indicator and attribute scores: Big Muddy Creek Subwatershed

Indicator	Indicator Score*	Attribute	Attribute Score**	Existing Condition
Water Quality	2.5 Impaired Function	TMDL - Impaired water quality: Dissolved Oxygen, Temperature	3	Impaired Function – 13% of stream miles in the subwatershed are impaired. Little Muddy Creek is listed Category 5 (impaired needing a TMDL) for Dissolved Oxygen, and Category 4A (impaired with approved TMDL) for temperature.
		Other: Sedimentation	2	Functioning at Risk - Road density in the subwatershed is 2.8 mi/mi ² for roads on NFS land with NFS jurisdiction, which is greater than Forest Plan direction of less than 2 mi/mi ² for general restoration subwatersheds to be considered functioning properly.
Water Quantity	1 Functioning Properly	Flow Characteristics	1	Functioning Properly - No known impoundments are present within the subwatershed, which allows stream hydrographs to function within normal range of variability.
Aquatic Habitat	2 Functioning at Risk	Habitat Fragmentation	2	Functioning at Risk - 15 barrier culverts in the subwatershed are blocking or partially blocking aquatic organism passage.
		Large Wood	2	Functioning at Risk – Large wood is low in Reaches 3 and 5 of Little Muddy Creek, and in Reach 1 of Big Muddy Creek.
		Channel Shape and Function	2	Functioning at Risk – 14% of stream length surveyed has width-to-depth ratios greater than expected under near natural conditions. This includes Reaches 2 and 4 of Little Muddy Creek.

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Indicator	Indicator Score*	Attribute	Attribute Score**	Existing Condition
Road/Trail Condition	2.5 Impaired Function	Open Road Density	2	Functioning at Risk - Closed roads not hydrologically stabilized were considered open for a road density of 2.8 mi/mi ² for open roads on NFS land with NFS jurisdiction, which is greater than Forest Plan direction of 2 mi/mi ² for general restoration subwatersheds to be considered functioning properly.
		Road Maintenance	3	Impaired Function - More than 50% of the stream crossings are undersized, and all maintenance level 1 roads have deferred maintenance on drainage features (e.g., ditches, water bars, and cross drains).
		Proximity to Water	3	Impaired Function – 50-55% of road miles are within 300’ of streams. More than 25% of road miles within 300’ of streams is considered Impaired Function per the WCF. Road density within 300’ of streams is 2.0 mi/mi ² .
		Mass Wasting	2	Functioning at Risk - There are a limited number of road segments located on landforms with mass wasting potential with moderate evidence of active movement. Some risk of delivery of large quantities of debris to stream channel reaches on Big Muddy and Little Muddy creeks exists.
Soils	1 Functioning Properly	Soil Productivity	1	Functioning Properly – The extent of detrimental soil conditions (DSC) in the subwatershed is not affecting soil function (See Soils report), and is estimated to be 4%, (including existing NFS roads and LIDAR-derived unauthorized routes).
		Soil Erosion	1	Functioning Properly – The presence of significant soil erosion was not detected in field survey data collected in 2018 and 2019. See Soils report.
		Soil Contamination	1	Functioning Properly – No contamination concerns were found during soil sampling performed in 2018 and 2019. See Soils report.

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Indicator	Indicator Score*	Attribute	Attribute Score**	Existing Condition
Aquatic Biota	3 Impaired Function	Life Form	3	Impaired Function - Fish distribution surveys give a rough estimate of the percentages of the different fish species present. The samples included Westslope Cutthroat Trout (27% Big Muddy / 0% Little Muddy), Brook trout (72% Big Muddy / 97% Little Muddy), Rainbow trout (1%), and sculpin (1-5%). The degraded condition of much of the subwatershed (moderate large wood and pool numbers) has reduced abundance of native fish (e.g., Westslope cutthroat trout).
		Native Species	3	Impaired Function - Westslope Cutthroat trout, Redband trout, sculpin are the native fish in this subwatershed. Westslope trout populations are in Big Muddy Creek, but compete for resources with eastern brook trout. They have not been found in Little Muddy Creek.
		Exotic/Invasive Species	3	Impaired Function - Brook trout inhabit most of the trout habitat in Big Muddy Creek and its tributaries, which contribute to negative interactions causing biological impediments. Brook trout can be predatory and competitive with Westslope Cutthroat Trout.
Riparian Vegetation	2 Functioning at Risk	Vegetation Condition	2	Functioning at Risk - 98% of the vegetation is in mid to late seral condition. However, some stands in the mid to late seral closed are demonstrating a moderate loss of vigor, reproduction, and growth, or changes in composition due to overstocking caused by fire suppression.
Fire Regime	2 Functioning at Risk	Fire Regime Condition Class	2	Functioning at Risk - the subwatershed is predominantly in the 33-66% departure from natural range of variability per FRCC modeling data. See Fuels report.
Forest Cover	1 Functioning Properly	Loss of Forest Cover	1	Functioning Properly. Less than 5 percent of NFS land in the subwatershed contains cut-over, denuded, or deforested forest land where appropriate forest cover should be reestablished or restored to achieve the desired conditions or other applicable Forest Plan direction for NFS lands. See Silviculturist report.
Rangeland Vegetation	1 Functioning Properly	Rangeland Vegetation Condition	1	Functioning Properly - Monitoring in 2017 estimated utilization of woody shrubs in the Tiger Hill Allotment at approximately 10%, placing the rangeland vegetation component at above 70%. See Range report.

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Indicator	Indicator Score*	Attribute	Attribute Score**	Existing Condition
Terrestrial Invasive Species	2 Functioning at Risk	Extent/Rate of Spread	2	Functioning at Risk - Predominant concerns in the subwatershed are invasive noxious weed populations, typically found along travel routes or frequently used meadow and wetland systems. These concerns are estimated to be found in the range of 10-25% of the subwatershed. Noxious weed populations are treated under the CNF Weeds EA (USDA 1988). Wildlife invasive species are limited to bull frog and are estimated to occur in less than 10% of the subwatershed.
Forest Health	2 Functioning at Risk	Insect and Disease	3	Impaired Function - Modeling data and stand walk-throughs indicate more than 40% of stand mortality is at risk of occurring in the forested stands within the subwatershed due to disease and/or by insect infestations. Mortality of more than 40% is considered impaired. See Silviculturist report.
		Ozone	1	Functioning Properly – Ozone damage is not known to occur on Colville National Forest (personal communication Karen Ripley, Forest Health Monitoring coordinator, PNW Research Station, July 2020).

*Average of all attribute scores within each indicator category: 1.0 - 1.6 = Functioning Properly; 1.7 - 2.2 = Functioning at Risk; 2.3 - 3.0 = Impaired Function.

**Attribute score: 1 = Functioning Properly; 2 = Functioning at Risk; 3 = Impaired Function.

2.2 WCF – Sweet Creek Subwatershed

Sweet Creek subwatershed is currently rated as Functioning at Risk (fair condition). Indicators for water quantity, soils, forest cover, and terrestrial invasive species are currently rated as Functioning Properly (good condition). Indicators for water quality, aquatic habitat, riparian vegetation, fire regime, and forest health are currently rated as Functioning at Risk (fair condition). Indicators for road/trail condition and aquatic biota are currently rated as Impaired Function (poor condition).

Table 4. WCF Existing Condition indicator and attribute scores: Sweet Creek Subwatershed

Indicator	Indicator Score*	Attribute	Attribute Score**	Existing Condition
Water Quality	2 Functioning at Risk	TMDL - Impaired water quality: Temperature	2	Functioning at Risk – 5% of stream miles are impaired in the subwatershed. Cedar Creek is listed Category 4A (impaired with approved TMDL) for temperature.
		Other: Sedimentation	2	Functioning at Risk - Road density for the subwatershed is 1.1 mi/mi ² for roads on NFS land with NFS jurisdiction, which is greater than Forest Plan direction of less than 1 mi/mi ² for focused restoration subwatersheds to be considered functioning properly.

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Indicator	Indicator Score*	Attribute	Attribute Score**	Existing Condition
Water Quantity	1 Properly Functioning	Flow Characteristics	1	Functioning Properly - No known impoundments are present within the subwatershed, and stream hydrographs are functioning within normal range of variability as determined through stream surveys and personal observations.
Aquatic Habitat	2 Functioning at Risk	Habitat Fragmentation	2	Functioning at Risk - 9 barrier culverts in the subwatershed are blocking or partially blocking aquatic organism passage.
		Large Wood	2	Functioning at Risk – Large wood is low in Reaches 4 and 6 of Cedar Creek; Reach 3 of Lost Lake Creek; and Reaches 3-5 of Jim Creek.
		Channel Shape and Function	2	Functioning at Risk - 65% of the surveyed stream length has width-to-depth ratios greater than expected under near natural conditions. This includes all reaches of Cedar Creek, and Reaches 1 and 3 of Jim Creek. Wolman pebble counts from the 2016 surveys show sediment levels exceeding 25% of the substrate counts in Reaches 2, 4, and 7, which indicates higher levels of sedimentation than natural conditions.
Road/Trail Condition	2.5 Impaired Function	Open Road Density	2	Functioning at Risk - Closed roads not hydrologically stabilized were considered open for a road density of 1.1 mi/mi ² for open roads on NFS land with NFS jurisdiction, which is greater than Forest Plan direction of 1 mi/mi ² for focused restoration subwatersheds to be considered functioning properly.
		Road Maintenance	3	Impaired Function - More than 50% of the stream crossings are undersized, and all maintenance level 1 roads have deferred maintenance on drainage features (e.g., ditches, water bars, and cross drains).
		Proximity to Water	3	Impaired Function - 35-42% of road miles are within 300' of streams. More than 25% of road miles within 300' of streams is considered Impaired Function per the WCF. Road density within 300' of streams is 0.8 mi/mi ² .
		Mass wasting	2	Functioning at Risk - There are a limited number of road segments located on landforms with mass wasting potential with moderate evidence of active movement. Some risk of delivery of large quantities of debris to stream channel reaches in Cedar Creek and unnamed tributaries exists.
Soils	1.3 Properly Functioning	Soil Productivity	1	Functioning Properly – The extent of detrimental soil conditions (DSC) in the subwatershed is not affecting soil function (See Soils report), and is estimated to be 3% (including existing NFS roads and unauthorized routes).
		Soil Erosion	1	Functioning Properly – The presence of significant soil erosion was not detected in field survey data collected in 2018 and 2019. See Soils report.
		Soil Contamination	1	Functioning Properly – No contamination concerns were found during soil sampling efforts performed in 2018 and 2019. See Soils report.

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Indicator	Indicator Score*	Attribute	Attribute Score**	Existing Condition
Aquatic Biota	2.7 Impaired Function	Life Form	3	Impaired Function - Fish distribution surveys give a rough estimate of the percentages of the different fish species present. The samples included Westslope Cutthroat Trout (50%), Brook trout (35%), Rainbow trout (15% in Cedar, but none in Jim Creek), and sculpin (5%). However, the degraded condition of much of the subwatershed (moderate large wood and pool numbers) has reduced abundance of native fish and cutthroat trout.
		Native Species	2	Functioning at Risk - Bull trout, Westslope Cutthroat trout, Redband trout, and sculpin are the native fish in this subwatershed. An eDNA study in 2016 indicated presence of bull trout in Cedar Creek in October. This may indicate that Cedar Creek is being used by bull trout from the Pend Oreille River. No documented spawning has occurred. Electroshocking surveys have not found bull trout. Westslope Cutthroat Trout populations are distributed throughout the subwatershed but compete for resources with eastern brook trout.
		Exotic/Invasive Species	3	Impaired Function: Brook trout inhabit most of the trout habitat in Cedar Creek and its tributaries which contribute to negative interactions causing biological impediments. Brook trout can be predatory and competitive with Westslope Cutthroat trout, and interbreed with bull trout.
Riparian Vegetation	2 Functioning at Risk	Vegetation Condition	2	Functioning at Risk - 98% of the vegetation is in mid to late seral condition. However, some stands in the mid seral closed are demonstrating a moderate loss of vigor, reproduction and growth, or changes in composition due overstocking caused by fire suppression.
Fire regime	2 Functioning at Risk	Fire Regime Condition Class	2	Functioning at Risk - the subwatershed is predominantly in the 33-66% departure from natural range of variability per FRCC modeling data. See Fuels report.
Forest Cover	1 Functioning Properly	Loss of Forest Cover	1	Functioning Properly - Less than 5 percent of NFS land in the subwatershed contains cut-over, denuded, or deforested forest land where appropriate forest cover should be reestablished or restored to achieve the desired conditions or other applicable Forest Plan direction for NFS lands. See Silviculturist report.
Terrestrial Invasive Species	1 Properly Functioning	Extent/Rate of Spread	1	Functioning Properly - Predominant concerns in the subwatershed are invasive noxious weed populations, typically found along travel routes or frequently used meadow and wetland systems. A large area of the subwatershed is designated Inventoried Roadless area (IRA)/Potential Wilderness area (PWA). The concerns for NFS lands in this subwatershed are estimated to be low and in the range of less than 10% of the subwatershed. Wildlife invasive species are limited to bull frog and are likely occur in less than 10 % of the subwatershed.

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Indicator	Indicator Score*	Attribute	Attribute Score**	Existing Condition
Forest Health	2 Functioning at Risk	Insect and Disease	3	Impaired Function – Modeling data and stand walk-throughs indicate more than 40% of stand mortality is at risk of occurring in the forested stands within the subwatershed due to disease and/or by insect infestations. Mortality of more than 40% is considered impaired. See Silviculturist report.
		Ozone	1	Functioning Properly – Ozone damage is not known to occur on Colville National Forest (personal communication Karen Ripley, Forest Health Monitoring coordinator, PNW Research Station, July 2020).

*Average of all attribute scores within each indicator category: 1.0 - 1.6 = Functioning Properly; 1.7 - 2.2 = Functioning at Risk; 2.3 - 3.0 = Impaired Function.

**Attribute score: 1 = Functioning Properly; 2 = Functioning at Risk; 3 = Impaired Function.

Table 5. WCF Existing Condition ecosystem process and subwatershed scores

Subwatershed	Ecosystem Process				Subwatershed Condition Rating**	Subwatershed Condition Class**
	Aquatic Physical Score*	Aquatic Biological Score*	Terrestrial Physical Score*	Terrestrial Biological Score*		
Big Muddy Creek	1.8	2.5	1.8	1.6	2.0	Functioning at Risk
Sweet Creek***	1.7	2.3	1.8	1.5	1.9	Functioning at Risk

*Average of indicator scores within each ecosystem process category.

**See USDA 2011 for weighted average score calculation. 1.0 - 1.6 = Functioning Properly (Good Condition); 1.7 - 2.2 = Functioning at Risk (Fair Condition); 2.3 - 3.0 = Impaired Function (Poor Condition).

***Ratings for Sweet Creek apply only to the portion of the subwatershed west of the Pend Oreille River.

3.0 Proposed Action

3.1 Direct & Indirect Effects

The boundary for direct and indirect effects on aquatic resources is Big Muddy Creek and Sweet Creek HUC 12 subwatersheds. The following direct and indirect effects assume that all recommended design elements and standard practices are implemented and perform effectively. Short-term refers to five years or less, while long-term refers to greater than five years. Direct effects occur at the time and place the proposed activities are implemented. Indirect effects occur offsite or later in time, and are defined as short-term or long-term.

3.2 Cumulative Effects

Cumulative effects can occur when the incremental impact of an action is added to impacts from past, present, and reasonably foreseeable actions. A description of past, present, and foreseeable actions is presented in the EA. The boundary for cumulative effects on aquatic resources is Big Muddy Creek and Sweet Creek HUC 12 subwatersheds.

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3.2.1 *WCF – Big Muddy Creek Subwatershed*

Big Muddy Creek subwatershed condition would be improved from Functioning at Risk to Functioning Properly. Proposed road work would improve, or move towards improvement, water quality, habitat fragmentation, life form presence, and open road density. Proposed treatments in RMAs would improve riparian vegetation condition and large wood recruitment. Proposed large wood additions would also improve aquatic habitat, floodplain connectivity, and channel shape and function.

Table 6. WCF Proposed Action indicator and attribute scores: Big Muddy Creek Subwatershed

Indicator	Indicator Score*	Attribute	Attribute Score**	Proposed Action
Water Quality	1.5 Functioning Properly	TMDL - Impaired waters: Temperature, Dissolved Oxygen, pH	2	Functioning at Risk - Silvicultural prescriptions adjacent to streams may in some cases reduce canopy closure in the short-term but would be designed to maintain or improve shading effect on streams in the long term and would thus maintain or improve water temperature conditions within the streams. Little Muddy Creek and an unnamed tributary have been identified for wood enhancement which may also have a beneficial effect on water temperature in the long term. Cumulative: No change is anticipated within the subwatershed.
		Other: Sedimentation	1	Functioning Properly - Road density for the subwatershed would be 1.9 mi/mi ² for roads on NFS land with NFS jurisdiction, which is just under Forest Plan direction of less than 2 mi/mi ² for general restoration subwatersheds to be considered functioning properly. Cumulative: Road density for all roads on NFS lands would decrease from 5.0 mi/mi ² to 3.5 mi/mi ² .
Water Quantity	1 Functioning Properly	Flow Characteristics	1	Functioning Properly - Harvest on 5,164 acres, or approximately 30% of the 17,661-acre subwatershed, is expected to move the forest stands back towards historic range of variability. Typically, approximately 1/3 of units are dropped during layout; therefore, approximately 20% of the watershed is expected to have harvest. The effect on water yield would be similar to the current existing forest stand condition, and would be immeasurable due to the small percentage of land being treated. Cumulative: Within the last 5 years, 39 acres have been treated within the subwatershed on private and State lands for a total 32% of the total land within the subwatershed proposed for treatment over a 10-year period. No foreseeable actions were identified in the subwatershed outside of the Forest boundary per a review of WADNR forest practices applications.
Aquatic Habitat	1.3 Functioning Properly	Habitat Fragmentation	1	Functioning Properly - All 15 barrier culverts in the subwatershed on NFS lands would be upgraded to aquatic organism passage structures. Once all barrier culverts have been replaced, habitat fragmentation on NFS lands would decrease and would not be a serious concern, and this indicator would be functioning properly. Cumulative: As barrier

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Indicator	Indicator Score*	Attribute	Attribute Score**	Proposed Action
				culverts on non-NFS lands within the subwatershed are replaced with aquatic organism passage structures, habitat connectivity would approach 100%.
		Large Wood	1	Functioning Properly - In RMAs, the goal is to increase the growth rate of trees by reducing competition through thinning. In time, these trees would fall into creeks and adjacent riparian areas. This should move towards restoring the recruitment rates in the subwatershed over the long-term. In addition to thinning, approximately 9.4 stream miles of large wood placement would increase large wood in reaches where wood counts are low (e.g., Reach 5 of Little Muddy Creek). Overall, large wood in streams would increase in this subwatershed. Cumulative: No other large wood placement outside of this project is expected in the foreseeable future.
		Channel Shape and Function	2	Functioning at Risk - No treatments would be completed in the two reaches with high width-to-depth ratios; however, 12 miles of proposed large wood placement elsewhere in the subwatershed would improve stream channel conditions and floodplain connectivity in other reaches. Less than 25% of the stream channels would have width-to-depth ratios above natural levels. Cumulative: No other known restoration efforts are planned in the subwatershed for the foreseeable future.
Road/Trail Condition	1.8 Functioning at Risk	Open Road Density	1	Functioning Properly - Closed roads not expected to be hydrologically stabilized were considered open for a road density of 1.9 mi/mi ² for open roads on NFS land with NFS jurisdiction, which is just under Forest Plan direction of 2.0 mi/mi ² for general restoration subwatersheds to be considered functioning properly. Cumulative: Road density for all roads on NFS lands would decrease from 5.0 mi/mi ² to 3.5 mi/mi ² .
		Road Maintenance	1	Functioning Properly - Undersized and passage barrier stream crossings have been identified for replacement and all maintenance level 1 roads are expected to be hydrologically stabilized (except where roads access private land). At completion, Best Management Practices (BMPs) would be appropriately applied to more than 75% of the road crossings and drainage features. Approximately 2.5 miles of unauthorized roads containing at least 5 stream crossings would be obliterated and crossings restored to natural character mimicking native conditions. Cumulative: In addition to stream crossing improvements on NFS land, a county bridge is planned for upgrade on Little Muddy Creek. WADNR has removed 2 culverts in the last 15 years.

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Indicator	Indicator Score*	Attribute	Attribute Score**	Proposed Action
		Proximity to Water	3	Impaired Function - 47% of open road miles would remain within 300' of streams (a reduction from 55%) and road density within 300' of streams would decline from 2.0 to 1.2 mi/mi ² . More than 25% of roads within 300' of streams is considered Impaired Function per WCF. Cumulative: Density of all roads, including LIDAR-derived unauthorized routes, would be 3.8 mi/mi ² with 46% within 300' of streams after completion of proposed road decommissioning and hydrologic stabilization of closed roads.
		Mass wasting	2	Functioning at Risk - No new roads would be constructed on unstable or landslide prone areas. The risk for failure on existing roads located in these areas would remain the same as the existing condition. Cumulative: With no proposed actions on unstable NFS lands, there would be no additive effect to actions on non-NFS lands.
Soils	1.3 Functioning Properly	Soil Productivity	1	Functioning Properly – Soil compaction would increase over the short- and long-term; however, with the implementation of project design features and standard practices to limit detrimental soil conditions, preserve soil productivity, and comply with Regional Soil Quality Guidelines and Forest Plan Standards, decreases in soil porosity from compaction should not negatively affect tree productivity (See Soils Report). As a result, it is not anticipated that the WCF measure for Functioning at Risk (5 to 25% of soils in the subwatershed compromised in ability to maintain resource values and sustain outputs) would occur. Cumulative: No other known activities are planned in the subwatershed for the foreseeable future that would affect soil productivity.
		Soil Erosion	1	Functioning Properly – Potential for slope stability failures would be expected to remain low, similar to the existing condition. The soil and geology of the area lends to maintaining stability overall (see Soils report). Cumulative: No other known activities are planned in the subwatershed for the foreseeable future that would affect soil erosion.
		Soil Contamination	1	Functioning Properly – BMPs would be expected to reduce risk for contamination concerns. Spills contaminating soils are expected to be reported to Department of Ecology and addressed appropriately. See Soils report. Cumulative: No other known activities are planned in the subwatershed for the foreseeable future that would affect soil contamination

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Indicator	Indicator Score*	Attribute	Attribute Score**	Proposed Action
Aquatic Biota	2.7 Impaired Function	Life Form	2	Functioning at Risk - Habitat changes from the large wood placement and aquatic organism passage would favor Westslope Cutthroat Trout populations. Approximately 70 - 90% of the life forms and communities should be present. Habitat improvements would create larger pools and habitat to sustain larger fish. Westslope Cutthroat Trout would be better able to compete with brook trout with improved habitat conditions. Native fish would have increased access to the watershed. Cumulative: Short-term increases in sediment may occur during road reconstruction and barrier culvert replacement activities, but would decrease sediment in the long term thereby improving native fish habitat.
		Native Species	3	Impaired Function - Unless the brook trout population is removed, brook trout would remain the dominant fish species. Habitat improvements would create larger pools and habitat to sustain larger fish. Westslope Cutthroat Trout would be better able to compete with brook trout with improved habitat conditions. Native fish would have increased access to the watershed. Cumulative: with no proposed brook trout suppression on NFS lands, there would be no additive effect to actions on NFS lands.
		Exotic/Invasive Species	3	Impaired Function - Unless the brook trout population is removed, brook trout would remain the dominant fish species. Habitat improvements would create larger pools and habitat to sustain larger fish. Westslope Cutthroat trout would be better able to compete with brook trout with improved habitat conditions. Native fish would have increased access to the watershed. Cumulative: with no proposed brook trout suppression on NFS lands, there would be no additive effect to actions on non-NFS lands.
Riparian Vegetation	1 Functioning Properly	Vegetation Condition	1	Functioning Properly – It is estimated that less than 10% of any vegetation treated along stream corridors, wetlands or water bodies would move from mid or late structural stages to an early structural stage. Of the acres treated there would be an increase in vigor and health with decreased competition as well as an increase in diversity in age structure, cover and composition. Cumulative: Since over half of the watershed would not be treated, over 50% of the riparian areas on NFS lands may still show signs of loss of vigor and growth due to overstocking and other management effects to riparian areas. See Silviculture report.
Fire regime	2 Functioning at Risk	Fire Regime Condition Class	2	Functioning at Risk - Big Muddy Creek subwatershed would trend towards FRCC-1: natural range of variability with completion of proposed forest stand and fuels treatments on approximately 30% of the subwatershed, however, at least 70 % of

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Indicator	Indicator Score*	Attribute	Attribute Score**	Proposed Action
				the subwatershed would remain in the 33-66% departure from natural range of variability per FRCC modeling data. Based on this high percentage of the subwatershed remaining in FRCC-2, the WCF score remains at a two. See Fuels report for additional information. Cumulative: No additional treatments are known of in the foreseeable future that would affect the subwatershed; therefore, cumulative effects are not expected to occur.
Forest Cover	1 Functioning Properly	Loss of Forest Cover	1	Functioning Properly – 5,164 acres, or 44% of the 11,629 acres on NFS lands within the subwatershed are anticipated to be treated. TSI treatments post-harvest would re-establish the HRV forest condition for the subwatershed, and within 15-20 years of harvest, stands would be expected to be at or nearly at 100% appropriate forest cover and have less than 20% of stand at risk of mortality due to disease and/or insect infestations. 25-50% reductions in acres treated are expected as viability is assessed, and other resource concerns are taken into consideration. Cumulative: Additional treatments on non-NFS lands would further move the subwatershed into a properly functioning condition. See Silviculture report.
Rangeland Vegetation	1	Rangeland Vegetation Condition	1	Functioning Properly - Proposed actions would allow transitory range areas to be more available with increases in available forage and the potential for greater distribution of cattle. The expected result would be reduced pressure on riparian areas. There would also be potential for increased drift from reduction in natural barriers by harvest operations. Overall, the change in utilization is expected be minimal. Design criteria include management actions to address drift concerns that develop due to the harvest operations. See Range report. Cumulative: No additional range allotments are planned in the foreseeable future; therefore, no additive effects to rangeland vegetation would occur.
Terrestrial Invasive Species	2 Functioning at Risk	Extent/Rate of Spread	2	Functioning at Risk - No new invasive wildlife species are anticipated as a result of this project. Invasive plant species are anticipated to be treated in the Big Muddy Creek subwatershed under the CNF Weeds EA (USDA 1988). The extent and rate of spread is expected to remain along the road corridors, skid trails, or landing sites. Invasive weed treatments would be applied and expected to maintain the occurrences to less than 25% of the subwatershed. Cumulative: Invasive weed populations would continue to be a concern along property boundary edges and potential for spread from non-NFS lands would remain a concern where treatments are not applied. See Wildlife and Botany reports for more

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Indicator	Indicator Score*	Attribute	Attribute Score**	Proposed Action
				information.
Forest Health	1.5 Functioning Properly	Insect and Disease	2	Functioning at Risk – Mortality from insect and disease in the forested stands would be treated through harvest, and is anticipated to decrease to a rate of less than 20% within the Big Muddy Creek subwatershed if all proposed harvest acres were treated. With 25-50% of proposed harvest units dropped due to viability or other resource concerns, the risk of mortality would be expected to be in the 20-40% range. Cumulative: Additional treatments within the subwatershed on non-NFS lands would further move the subwatershed towards functioning properly condition. See Silviculture report.
		Ozone	1	Functioning Properly – Increased vehicular exhaust for this project would be minimal and short-term, and is not anticipated to cause ozone related damage to the forest. Cumulative: No adverse effect would occur from other known project actions within the subwatershed.

*Average of all attribute scores within each indicator category: 1.0 - 1.6 = Functioning Properly; 1.7 - 2.2 = Functioning at Risk; 2.3 - 3.0 = Impaired Function.

**Attribute score: 1 = Functioning Properly; 2 = Functioning at Risk; 3 = Impaired Function.

3.2.2 WCF – Sweet Creek Subwatershed

Sweet Creek subwatershed would improve from Functioning at Risk to Functioning Properly. Proposed road work would improve water quality, habitat fragmentation, life form presence, and open road density. Proposed treatments in RMAs would improve riparian vegetation condition and large woody recruitment. Large woody debris additions would also improve aquatic habitat, floodplain connectivity, and channel shape and function.

Table 7. WCF Proposed Action indicator and attribute scores: Sweet Creek Subwatershed

Indicator	Indicator Score*	Attribute	Attribute Score**	Proposed Action
Water Quality	1.5 Properly Functioning	TMDL - Impaired waters: Temperature, Bacteria, DO, pH	2	Functioning at Risk - Silvicultural prescriptions adjacent to streams may in some cases reduce canopy closure in the short term but would be designed to maintain or improve shading effect on streams in the long term and would thus maintain or improve water temperature conditions within the streams. Cedar Creek has been identified for wood enhancement which may have a beneficial effect on water temperature. Cumulative: No change is anticipated within the subwatershed.
		Other: Sedimentation	1	Functioning Properly - Road density for the subwatershed would be 0.9 mi/mi ² for roads on NFS land with NFS jurisdiction, which is just under Forest Plan direction of less than 1 mi/mi ² for focused restoration subwatersheds to be considered functioning properly. Cumulative: Road density for all roads on NFS lands would decrease from 2.2 to 1.9 mi/mi ² .

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Water Quantity	1 Functioning Properly	Flow Characteristics	1	Functioning Properly - Harvest on 2,700 acres, or 10% of the Sweet Creek subwatershed west of the Pend Oreille River (i.e., 26,525 acres), is expected to move the forest stands back towards historic range of variability. The effect on the water yield would be similar to the current existing forest stand condition and would be unmeasurable due to the small percentage of land being treated. Cumulative: Within the last 5 years, 312 acres have been treated within the subwatershed on private and State lands for a total 12% of the land proposed for treatment over a 10-year period. No foreseeable actions were identified in the subwatershed outside of the Forest Boundary per WADNR forest practices applications.
		Habitat Fragmentation	1	Functioning Properly - All 9 barrier culverts would be upgraded to aquatic organism passage structures. Once all barrier culverts have been replaced, habitat fragmentation would decrease and would not be a serious concern, and this indicator would be functioning properly. Cumulative: As barrier culverts on non-NFS lands within the subwatershed are replaced with aquatic organism passage structures, habitat connectivity would approach 100%.
Aquatic Habitat	1.3 Functioning Properly	Large Wood	1	Functioning Properly - In areas with riparian thinning, the goal is to increase the growth rate of trees by reducing competition. Eventually, these trees would fall into the creek and adjacent riparian area. This should move towards restoring the recruitment rates in the watershed. Reaches 4 and 5 of Jim Creek and Reach 4 of Lost Lake Creek have treatments that would improve vegetation structure (Units 2, 3, 7, 11). Reaches 2, 4, and 6 of Cedar Creek have riparian thinning and wood placement proposed. Approximately 2.7 stream miles of large wood placement would increase large wood in reaches where wood counts are low in Cedar Creek. Overall large wood in streams would increase especially in reaches where the wood is low. Cumulative: No other large wood placement outside of this project is expected in the foreseeable future.
		Channel Shape and Function	2	Functioning at Risk - Reaches 2, 4, and 6 of Cedar Creek have wood placement proposed which would improve channel shape and function. Large woody debris would also improve the sorting of the substrate. The large woody debris should improve connection of the floodplain where floods would be able to leave the channel and reduce scour on stream banks and deposit sediment on the floodplain. Some sedimentation is expected from road reconstruction activities. However, removal of riparian roads, large woody debris placement and following best management processes, the sediment should not be noticeably measurable beyond current levels. Less than 25% of the stream channels would have width-to-depth ratios above natural levels. Floodplain connection would be improved. Cumulative: Outside of this project, no other known restoration efforts are planned in the subwatershed for the foreseeable future.
		Open Road Density	1	Functioning Properly - Closed roads not expected to be hydrologically stabilized were considered open for road density calculation of 0.9 mi/mi ² for roads on NFS land with NFS jurisdiction, which is just under Forest Plan direction of 1 mi/mi ² for focused restoration subwatersheds to be considered functioning properly. Cumulative: Road density for all roads on NFS lands would decrease from 2.2 to 1.9 mi/mi ² .

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Road/Trail Condition	1.8 Functioning at Risk	Road Maintenance	1	Functioning Properly - Undersized and passage barrier stream crossings have been identified for replacement and all maintenance level 1 roads are expected to be hydrologically stabilized. At completion, BMPs would be appropriately applied to more than 75% of the road crossings and drainage features. About 5.5 miles of unauthorized roads containing at least 10 stream crossings would be obliterated and crossings restored to natural character mimicking native conditions. Cumulative: In addition to stream crossing improvements on NFS Land, a county bridge is planned for upgrade on Cedar Creek. WADNR has constructed 3.1 miles of road, added four culverts, abandoned 0.5 miles of road, removed a log puncheon, and removed 2 culverts in the last 5 years. With these combined effects there is a net decrease of road density and crossings in the subwatershed on all lands.
		Proximity to Water	3	Impaired Function – Approximately 35% of road miles are within 300' of streams, this would be a reduction from 41% and the density of open roads within 300' of streams would decline from 0.8 mi/mi ² to 0.5 mi/mi ² . More than 25% of roads within 300' of streams is considered Impaired Function per WCF matrix for determining watershed function. Cumulative: All roads, including lidar derived, density would be 3.0 mi/mi ² with 38% within the RMA after all road decommissioning and hydrologic stabilization of closed roads is completed.
		Mass wasting	2	Functioning at Risk - No new roads would be constructed on unstable or landslide prone areas. The risk for failure on existing roads located in these areas would remain the same as the existing condition. Cumulative: with no Proposed actions on NFS lands on unstable lands, there would be no cumulative effect.
		Soil Productivity	1	Functioning at Risk – Soil compaction would increase over the short- and long-term; however, with the implementation of project design features and standard practices to limit detrimental soil conditions, preserve soil productivity, and comply with Regional Soil Quality Guidelines and Forest Plan Standards, decreases in soil porosity from compaction should not negatively affect tree productivity (See Soils Report). As a result, it is not anticipated that the WCF measure for Functioning at Risk (5 to 25% of soils in the subwatershed compromised in ability to maintain resource values and sustain outputs) would occur. Cumulative: No other known activities are planned in the subwatershed for the foreseeable future that would affect soil productivity.
Soils	1.3 Functioning Properly	Soil Erosion	1	Functioning Properly – Potential for slope stability failures and is expected to remain low, similar to the existing condition. The soil and geology of the area lends to maintaining stability overall (see Soils Report). Cumulative: No other known activities are planned in the subwatershed for the foreseeable future that would affect soil erosion.
		Soil Contamination	1	Functioning Properly – Best Management Practices are expected to reduce risk for contamination concerns. Spills contaminating soils are expected to be reported to Department of Ecology and addressed appropriately. Cumulative: No other known activities are planned in the subwatershed for the foreseeable future that would affect soil contamination.

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		Life Form	2	Functioning at Risk - 70 - 90% of the life forms and communities should be present. Habitat changes from the large woody debris placement and aquatic organism passage would favor Westslope Cutthroat Trout and bull trout populations. Habitat improvements would create larger pools and habitat to sustain larger fish. Westslope Cutthroat trout and Bull Trout would be better able to compete with brook trout with improved habitat conditions. Bull trout would have increased access to the watershed. Cumulative: If man-made barriers are removed or replaced using the design criteria screening, on both NFS and non-NFS lands, there would be an overall increase in connectivity throughout the watershed for native species.
Aquatic Biota	2.3 Impaired Function	Native Species	2	Functioning at Risk - Habitat improvements would promote native fish. Habitat improvements would create larger pools and habitat to sustain larger fish. Westslope Cutthroat Trout and bull trout would be better able to compete with brook trout with improved habitat conditions. Bull trout would have increased access to the watershed. This indicator would be maintained until the brook trout population is removed. Cumulative: with no proposed brook trout suppression NFS lands, there would be no additive effect to actions on non-NFS lands.
		Exotic/Invasive Species	3	Impaired Function - Unless the brook trout population is removed, brook trout would remain the system. Habitat improvements would create larger pools and habitat to sustain larger fish. Westslope Cutthroat Trout and bull trout would be better able to compete with brook trout with improved habitat conditions. Bull trout would have increased access to the watershed. Cumulative: With no proposed brook trout suppression NFS lands, there would be no additive effect to actions on non-NFS lands.
Riparian Vegetation	2 Functioning at Risk	Vegetation Condition	2	Functioning at Risk - It is estimated that less than 10% of any vegetation treated along stream corridors, wetlands or water bodies would move from mid or late structural stages to an early structural stage. Of the acres treated. Of the acres treated there would be an increase in vigor and health with decreased competition as well as an increase in diversity in age structure, cover and composition. Cumulative: Since over half of the watershed would not be treated, over 50% of the riparian areas on NFS lands may still show signs of loss of vigor and growth due to overstocking and other management effects to riparian areas. See Silviculture Report.
Fire regime	2 Functioning at risk	Fire Regime Condition Class	2	Functioning at risk - Sweet Creek subwatershed would trend towards FRCC-1: natural range of variability with completion of proposed forest stand and fuels treatments on approximately 10% of the subwatershed, however, at least 90 % of the subwatershed would remain in the 33-66% departure from natural range of variability per FRCC modeling data. Based on this high percentage of the subwatershed remaining in FRCC-2, the WCF score remains at a two. See Fuels report for additional information. Cumulative: No additional treatments are known of in the foreseeable future that would affect the subwatershed as a whole.
Forest Cover	1 Functioning Properly	Loss of Forest Cover	1	Functioning Properly – 2,700 acres, or 36% of the 7,512 acres on NFS lands within the Sweet Creek subwatershed west of the Pend Oreille River, are anticipated to be treated. TSI treatments post-harvest would re-establish the HRV forest condition for the subwatershed, and within 15-20 years of harvest, stands would be expected to be at or nearly

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				at 100% appropriate forest cover and have less than 20% of stand at risk of mortality due to disease and/or insect infestations. 25-50% reductions in acres treated are expected as viability is assessed, and other resource concerns are taken into consideration. Cumulative: Additional treatments on non-NFS lands would further move the whole watershed into the properly functioning state.
Terrestrial Invasive Species	1 Functioning Properly	Extent/Rate of Spread	1	Functioning Properly - No new invasive wildlife species are anticipated as a result of this project. Invasive plant species are anticipated to be treated in the Sweet Creek subwatershed under the CNF Weeds EA (USDA 1988). Invasive weed treatments would be applied and expected to maintain the occurrences to less than 10% of the subwatershed. Cumulative: Invasive weed populations would continue to be a concern along property boundary edges and potential for spread from non-NFS lands would remain a concern where treatments are not applied.
Forest Health	1.5 Functioning Properly	Insect and Disease	2	Functioning at Risk – Mortality from insect and disease in the forested stands would be treated through harvest, and is anticipated to decrease to a rate of less than 20% within the Sweet Creek subwatershed if all proposed harvest acres were treated. With 25-50% of proposed harvest units dropped due to viability or other resource concerns, the risk of mortality would be expected to be in the 20-40% range. Cumulative: Additional treatments within the subwatershed on non-NFS lands would further move the subwatershed towards functioning properly condition. See Silviculture Report.
		Ozone	1	Functioning Properly – Increased vehicular exhaust for this project would be minimal and short-term, and is not anticipated to cause ozone related damage to the forest. Cumulative: No adverse effect would occur from other known project actions within the subwatershed.

*Indicator score is the average of all attribute scores within each indicator category: 1.0 - 1.6 = Functioning Properly; 1.7 - 2.2 = Functioning at Risk; 2.3 - 3.0 = Impaired Function.

**Attribute score: 1 = Functioning Properly; 2 = Functioning at Risk; 3 = Impaired Function.

Table 8. WCF Proposed Action ecosystem process and subwatershed scores

Subwatershed	Ecosystem Process				Subwatershed Condition Rating**	Subwatershed Condition Class**
	Aquatic Physical Score*	Aquatic Biological Score*	Terrestrial Physical Score*	Terrestrial Biological Score*		
Big Muddy Creek	1.4	1.8	1.4	1.5	1.5	Functioning Properly
Sweet Creek***	1.3	2.2	1.4	1.5	1.6	Functioning Properly

*Average of indicator scores within each ecosystem process category.

**See USDA 2011 for weighted average score calculation. 1.0 - 1.6 = Functioning Properly (Good Condition); 1.7 - 2.2 = Functioning at Risk (Fair Condition); 2.3 - 3.0 = Impaired Function (Poor Condition).

*** Ratings for Sweet Creek apply only to the portion of the subwatershed west of the Pend Oreille River.

4.0 No Action

If no action is taken, no new roads (e.g., temporary) would be constructed, and potential negative short-term impacts to aquatic resources from road construction would not occur. However, 26 miles of closed road hydrologic stabilization and nine miles of road decommissioning would also not occur. Total road densities within RMAs would not change, and the potential reduction in sediment delivery to streams from road surfaces would not occur. Road networks are known to be chronic sources of sediment delivery to streams, and contribute to increases in runoff and peaks flows. Existing road conditions would continue to have a higher risk for culverts plugging, roads washing out, and increased sediment delivery to streams due to lower standards used in the past resulting in undersized culverts. The 24 known barrier culverts to aquatic organism passage would persist.

If no action is taken there would be no new direct effects on any fish species as no activity would take place in or adjacent to any fish habitat. No action would be taken to improve water storage capacity, fish passage, and habitat. There would be no long-term beneficial effects on fish habitat by thinning overstocked conifers from riparian areas or decommissioning, closing, reconstructing, relocating and maintaining roads.

Roads would continue to be a dominant cause of fish habitat degradation and impairment to stream connectivity. If no action were taken, the Sweet-Ione Project Area would remain in its current condition, and undesirable fish habitat, passage, and hydrologic function condition would persist into the foreseeable future.

5.0 Monitoring

Stream temperature and bacteria monitoring would be performed annually to identify the status and trend of water quality impaired streams per a Memorandum of Agreement with the Washington Department of Ecology. Harvest and fuels treatment units, decommissioned roads, and hydrologically stabilized closed roads would be field reviewed for implementation effectiveness. Temporary roads would be field reviewed during use for implementation effectiveness, and for post-use obliteration effectiveness.

6.0 Summary

Table 9. Summary of Effects Determination for Fish Species

Species	Status	Project Area Occurrence	Determination	Rationale for determination
Bull Trout	T	Y	NLAA	On the basis of the above evaluation, implementation of the proposed action and associated design criteria is Not Likely to Adversely Affect bull trout. The proposed project may impact individual bull trout, although this is not expected to occur due to the very low number of bull trout known to occur in Cedar Creek. Therefore, the Sweet-Ione Ecological Restoration Project would not contribute to a negative trend in viability on the listed bull trout.
Bull Trout Critical Habitat	T	Y	NLAA	Implementation of the proposed action and associated design criteria is Not Likely to Adversely Affect bull trout critical habitat. Potential short-term sediment inputs from watershed restoration projects is possible, but

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Species	Status	Project Area Occurrence	Determination	Rationale for determination
				these projects would result in long-term Beneficial Effects for Critical Habitat in Cedar Creek. This project would not result in a negative trend in Bull Trout Critical Habitat.
Westslope cutthroat trout	S & MIS	Y	BE/MIH	Implementation of the proposed action May impact individuals or habitat but is not likely to result in a trend toward federal listing , and continued viability is expected. The project is not expected to prevent attainment of riparian management objectives as described in the Inland Native Fish Strategy, provided the standard practices are implemented as included in this report.
Kokanee	MIS	N	NI	Not present, no impact.
Pygmy Whitefish	S	N	NI	Not present, no impact.
Umatilla Dace	S	N	NI	Not present, no impact.
Lake Chub	S	N	NI	Not present, no impact

6.1 Compliance with the Forest Plan and Other Relevant Laws, Regulations, and Policies

The proposed project is consistent with all applicable Forest Plan standards and guidelines, as shown in Table 10.

Table 10. Consistency with the Forest Plan

Forest Plan Component	Forest Plan Consistency
FW-STD-WR-01. Best Management Practices	BMP are included in the standard practices. Analysis completed with assumption BMPs would be implemented effectively
FW-STD-WR-02. Aquatic Invasive Species – In-Water Work	Included in design elements and standard practices where applicable. Fish work windows guidelines will be followed, and exceptions will be made through interagency communication
FW-STD-WR-03. Aquatic Invasive Species – Aquatic Resource Sampling	Does not apply to this project
FW-STD-WR-04. Construction of New Roads, Trails and Developed Recreation Sites	New road construction would be designed to minimize, to the extent possible, the effects, impacts, and disruption to the hydrologic processes as described in the standard practices
FW-STD-WR-05. Road Construction and Hydrologic Risk Reduction in Key Watersheds	Road construction logistics are included in the standard practices, a net decrease in road density is proposed for this project.
FW-STD-WR-06. Hydroelectric and Other Water Development Authorizations in Key Watersheds	Does not apply to this project
FW-STD-WR-07. New Hydroelectric Facilities and Water Developments	Does not apply to this project

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Forest Plan Component	Forest Plan Consistency
MA-STD-FR-01. Road Construction and Hydrologic Risk Reduction	Road construction logistics are included in the standard practices, a net decrease in road density is proposed for this project.
MA-STD-RMA-01. Chemical Application	Chemical application processes are incorporated via standard practices and BMPs
MA-STD-RMA-02. Personal Fuelwood Cutting	Does not apply to this project
MA-STD-RMA-03. Timber Harvest and Thinning	Timber harvest and other silvicultural practices that occur in RMAs will only occur where necessary to attain desired conditions for aquatic and riparian resources. All RMA harvest will be under a specific silviculture prescription to benefit overall aquatic system health. Vegetation in RMAs will not be subject to scheduled timber harvest.
MA-STD-RMA-04. Yarding Activities	When yarding over streams, full suspension is required - Included in standard practices/design elements.
MA-STD-RMA-05. Road and Trail Construction and Maintenance	The standard practices include BMPs to insure there shall be no side-casting or placement of fill in Riparian Management Areas, except where needed to construct or replace stream crossings.
MA-STD-RMA-06. Road and Trail Construction at Stream Crossings	Standard practices identify all new or replaced permanent stream crossings shall accommodate at least the 100-year flood and its bedload and debris. The 100-year flood estimates will reflect the best available science regarding potential effects of climate change
MA-STD-RMA-07. Road and Trail Construction - Fish Passage	The Standard practices require the proposed action to follow BMP and design criteria that shall provide and maintain passage for all life stages of all native and desired non-native aquatic species and for riparian-dependent organisms where connectivity has been identified as an issue. Exceptions may be determined necessary when isolated native fish populations would be put at risk by implementing full passage structures per design criteria. Crossing designs shall reflect the best available science regarding potential effects of climate change on peak flows and low flows.
MA-STD-RMA-08. Management of Livestock Grazing to Attain Desired Conditions	Does not apply to this project
MA-STD-RMA-09. Recreational and Permitted Grazing Management-Livestock Handling, Management, and Water Facilities	Does not apply to this project
MA-STD-RMA-10. Permitted Grazing Management - Allotment Management Planning	Does not apply to this project
MA-STD-RMA-11. Wildland Fire and Fuels Management - Minimum Impact Suppression Tactics	Does not apply to this project
MA-STD-RMA-12. Wildland Fire and Fuels Management - Portable Pumps	Included in standard practices and BMPs for fuels treatments
MA-STD-RMA-13. Water Drafting	Included in standard practices and BMPs
MA-STD-RMA-14. Aerial application of Fire Chemicals	Does not apply to this project

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Forest Plan Component	Forest Plan Consistency
MA-STD-RMA-15. Lands and Special Uses Authorizations	Does not apply to this project
MA-STD-RMA-16. Hydroelectric - New Support Facilities	Does not apply to this project
MA-STD-RMA-17. Mineral Operations in RMAs	Does not apply to this project
MA-STD-RMA-18. Operating Plans for Existing Activities	Does not apply to this project
MA-STD-RMA-19. Structures and Support Facilities	Does not apply to this project
MA-STD-RMA-20. Mine Waste	Does not apply to this project
MA-STD-RMA-21. Leasable Exploration and Development	Does not apply to this project
MA-STD-RMA-22. Salable Minerals	Does not apply to this project
MA-STD-RMA-23. Inspection and Monitoring of Mineral Plans, Leases, and Permits	Does not apply to this project
MA-STD-RMA-24. Suction Dredge and Placer Mining	Does not apply to this project
FW-GDL-WR-01. Properly Functioning Watersheds	Proposed action moves Big Muddy Creek and Sweet Creek subwatersheds towards proper function with stand treatments, road density reduction, and large wood addition.
FW-GDL-WR-02. Aquatic Invasive Species – Wildfire Suppression Equipment	Does not apply to this project
FW-GDL-WR-03. Aquatic Invasive Species– Early Detection and Rapid Response	This guideline is outside the scope of this project.
FW-GDL-WR-04. Watershed Restoration	The proposed action is developed to restore the watershed condition with the maximum long-term benefit as the overall objective.
FW-GDL-WR-05. Hydrologic Function of Roads, Trails, and Developed Recreation Sites	Standard practices include reconstruction criteria and BMPs to minimize impact on streams to the extent feasible
FW-GDL-WR-06. Chemical Fire Suppression	Does not apply to this project
FW-GDL-LG-01. Threatened and Endangered Species Habitat in Riparian Areas in Grazing Allotments.	Does not apply to this project – No Grazing allotments on NFS lands within the project area.
MA-GDL-GR-01. Roads	Standard practices, design elements, and BMPs are incorporated to maintain or enhance water quality to contribute to state standards attainment
MA-GDL-RMA-01. Aquatic and Riparian Conditions	With the proposed project, project activities including fish passage, roads, RMA thinning should restore or not retard attainment of desired conditions through implementation which incorporates the prescribed standard practices, design criteria, and BMPs.
MA-GDL-RMA-02. Fuel Storage	included in standard practices
MA-GDL-RMA-03. Felling Trees	Trees felled in the RMA are addressed in the 2-zone strategy in the standard practices
MA-GDL-RMA-04. Landings, Skid Trails, Decking, and Temporary Roads	Included in the standard practices to be incorporated into the contract
MA-GDL-RMA-05. Road Construction	Included in the standard practices to be incorporated into layout design

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Forest Plan Component	Forest Plan Consistency
MA-GDL-RMA-06. Temporary Road Reconstruction	Standard practices identify non-system road prisms within RMAs to be utilized with the purpose to decommission post-harvest activities
MA-GDL-RMA-07. Road and Trail Construction - Wetlands and unstable Areas	Standard practices include avoidance of wetland and unstable areas for road building
MA-GDL-RMA-08. Road and Trail Construction - Drainage	Included in standard practices
MA-GDL-RMA-09. Road and Trail Construction - Passage for Riparian Dependent Species	State standards are met when stream crossings are replaced, and aquatic organism passage is a concern
MA-GDL-RMA-10. Road and Trail Construction - Minimization of Diversion Potential	Standard practices include design practices of new/reconstructed crossing structures
MA-GDL-RMA-11. Fish Passage Barriers-	All unnatural fish passage barriers will be either replaced or removed with proposed action
MA-GDL-RMA-12. Annual Grazing Use Indicators	Does not apply to this project
MA-GDL-RMA-13. Recreational and Permitted Grazing Management- Livestock Handling Activities	Does not apply to this project
MA-GDL-RMA-14. Recreational and Permitted Grazing Management- Fish Redds	Vegetation treatment design criteria are provided to maintain effective barriers to stream access by recreational grazing activities. No permitted grazing within this project area.
MA-GDL-RMA-15. Recreation Management - New Facilities and Infrastructure	Proposed actions for new trails and trailheads would follow new Forest Plan direction.
MA-GDL-RMA-16. Recreation Management - Existing Facilities	Existing recreation facilities will be retained and managed for existing purposes.
MA-GDL-RMA-17. Wildland Fire and Fuels Management - Temporary Fire Facilities	Does not apply to this project
MA-GDL-RMA-18. Water Drafting Sites	Incorporated into standard practices to be included in contract
MA-GDL-RMA-19. Wildland Fire and Fuels Management - Fire Line Construction	Included in standard practice as BMP for fuels treatment operations
MA-GDL-RMA-20. Wildland Fire and Fuels Management - Burning Masticated Fuels	Included in standard practices
MA-GDL-RMA-21. Direct Ignition	Standard practices provide direction to have no direct ignition in RMA with fire allowed to creep into RMA on its own
MA-GDL-RMA-22 Hydroelectric - Existing Support Facilities	Does not apply to this project

6.2 Consistency with other Federal Regulations

6.2.1 Clean Water Act

The Clean Water Act stipulates that states are to adopt water quality standards. Included in these standards are provisions for identifying beneficial uses, establishing the status of beneficial uses, setting water quality criteria, and establishing BMPs to control nonpoint sources of pollution. EO 12088 also requires the Forest Service to meet the requirements of the Clean Water Act.

Section 313 of the Clean Water Act requires federal agencies to comply with all federal, state, interstate, and local requirements with respect to control and abatement of water pollution, and to cooperate with relevant processes and sanctions and administrative authority.

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Section 303(d) of the Clean Water Act stipulates that states must identify and prioritize water bodies that are water quality limited (i.e., water bodies that do not meet water quality standards). For waters identified on this list, states must develop a total maximum daily load (TMDL) for the pollutants, set at a level to achieve water quality standards.

By reference, consistency with Forest Plan standards and guidelines, and the implementation of applicable standard practices and design elements specified in the EA, ensures consistency with the Clean Water Act.

6.2.2 *Executive Orders 11988 and 11990*

These orders provide for protection and management of floodplains and wetlands. The Sweet-Ione Project does not propose to occupy floodplains to an extent greater than already exists, nor does it propose to modify or impact wetlands. As such, there would be no adverse impacts to floodplains or wetlands, thereby complying with EO 11988 and EO 11990.

6.2.3 *Endangered Species Act*

The ESA requires the Forest Service to manage for the recovery of threatened and endangered species and the ecosystems upon which they depend. Forests are required to consult with the FWS or the NMFS if a proposed activity may affect the population or habitat of a listed species. There are federally listed fish species and their designated critical habitat in the project area. Consultation is currently taking place.

6.2.3.1 *Threatened and Endangered (T&E) Species*

The project area is entirely included within the boundaries of Pend Oreille County, Washington. For this county, the USDI Fish and Wildlife Service presently lists one species, Bull Trout, as threatened under the Endangered Species Act of 1973 (http://www.fws.gov/wafwo/species_new.html). Table 11 displays information for Bull Trout relative to the project area.

Table 11. Threatened fish species list for the Colville National Forest

Species	Status	Critical Habitat present?	Documented in the area?	Addressed in this report?	Habitat description and other comments
Bull Trout (<i>Salvelinus confluentus</i>)	Threatened	Yes	Yes	Yes, 2016 eDNA testing showed bull trout DNA present in Cedar Creek. The last sighting of bull trout in the stream was in 1995; one adult bull trout was found in the pool formed by the impassable former municipal dam.	The Columbia Headwaters Recovery Unit (CHRU) includes western Montana, northern Idaho, and the northeastern corner of Washington. The bull trout populations and critical habitat assessed in this BA are in Cedar Creek; part of the Lower Clark Fork geographic area and Lake Pend Oreille Core Area.

Bull trout (threatened)

Management Framework

Regulations implementing the Endangered Species Act (50 CFR 402.02) define the environmental baseline as the past and present impacts of all Federal, State, or private actions and other human activities in the Cedar creek drainage. Also included in the environmental baseline are the anticipated impacts of all proposed federal projects in the Cedar creek drainage that have already undergone section 7 consultation, and the impacts of state and private actions which are contemporaneous with the consultation in progress.

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The US Fish and Wildlife Service (USFWS) designated critical habitat (Figure 2) for the Columbia River bull trout populations September 25, 2005 (70 FR 56212). On October 18, 2010, the USFWS revised the 2005 critical habitat designation (75 FR 63898) based on extensive review of the previous critical habitat proposals and designation, as well as new information received during the 2010 public review process.

The Cedar Creek drainage is within the Clark Fork River CHU. The final rule designated the Pend Oreille River from the crest of Boundary Dam to Albeni Falls Dam, and several tributaries within the range, as critical habitat for bull trout. Critical habitat for the Cedar creek drainage is in the Sub-unit Lake Pend Oreille (Unit 31). The Pend Oreille is a “core” area within the recovery unit (USFWS 2010). A core area consists of habitats that provide elements necessary for every stage of life (USFWS 2010). Cedar Creek is within the core area and was identified as designated critical habitat. There are 4.9 miles of bull trout critical habitat in Cedar Creek.

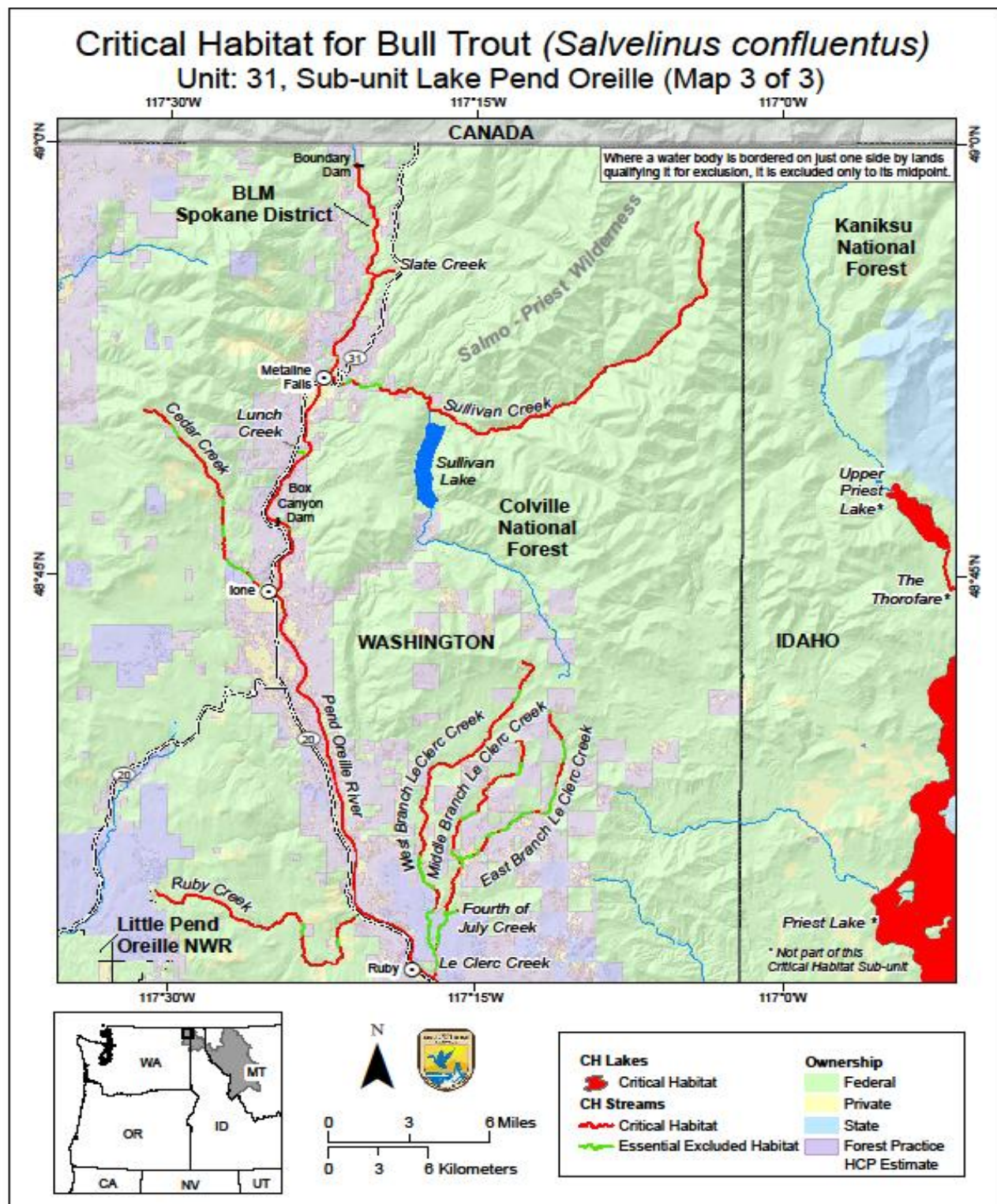


Figure 2. Critical Habitat for Bull Trout in Lake Pend Oreille Sub-Unit

Regional Existing Population Condition

Bull trout are native to the Pacific Northwest and are found in North America from the Oregon-California border eastward to Nevada, north through western Montana and western Alberta, westward through British Columbia, and north to at least 60 degrees N latitude in Alaska (Wydoski and Whitney 2003). Natural climatic warming and loss of coldwater habitat since the Pleistocene period exacerbated by effects of human activities have reduced their distribution (Cavender 1978). Individual bull trout have been found in Box Canyon Reservoir, a 55-mile segment of the Pend Oreille River from Box Canyon Dam to Albeni Falls Dam. Adult migratory bull trout have been captured in the reservoir between 1988 and 2016 (data in project files).

Documentation exists that bull trout occupied the Columbia River as early as the 19th century (USFS 1998). From the 1930s through the 1970s, dams were built on the Columbia River and major tributaries in the U.S. and Canada. This changed fluvial habitat into the present reservoirs. Several of these dams did not provide for upstream fish passage, including Grand Coulee Dam (USFWS 2002). These dams isolated the existing population of bull trout into smaller populations. These projects also modified the habitat by increasing water temperatures and eliminating the original complexity of habitat which included turbulence, riffles, and pools.

Bull trout from Lake Pend Oreille historically migrated downstream into the Pend Oreille River and spawned in tributaries. With the construction of the Albeni Falls and Box Canyon Dams, this life history form in the Pend Oreille River has been mostly lost. Currently this life history only exists in the East River of the Priest River drainage, upstream of Albeni Falls Dam. The Clark Fork River Critical Habitat Unit (CHU) also has the second largest adfluvial core habitat area in its range (see inset map of Figure 2). Bull trout population size within the entire Clark Fork River CHU is above 10,000 individuals. However, in the Lower Pend Oreille River (below Albeni Falls and including Cedar Creek), the population of bull trout is below 500 with no known spawning population existing (Figure 2).

Existing Population Condition

Cedar Creek flows into the Pend Oreille River. A dam 1.2 miles from the mouth of Cedar Creek was removed in 2005. There are 4.9 miles of bull trout critical habitat in Cedar Creek. Population surveys were done in 1992, 1994, 1995, 1998, 1999, 2004-2007, 2012, 2015 and 2016. The last sighting of bull trout in the stream was by a snorkel survey in 1995, where one adult bull trout was found in the pool formed by the impassable former municipal dam. The critical habitat in the Pend Oreille Core area was tested by the Colville National Forest using environmental DNA sampling in the summer of 2015 and 2016. Selected sites have been tested every year since 2015. Bull trout DNA were detected in Cedar Creek (2016), West Branch LeClerc Creek (2015, 2016, 2018, 2019), and Middle Branch LeClerc Creek (2015).

Current Critical Habitat Condition Rangewide

Bull trout population levels are influenced by the condition of bull trout habitat. The condition of bull trout critical habitat varies across the range from poor to good. Although still relatively widely distributed across its historic range, bull trout occurs in low numbers in many areas, and populations are considered depressed or declining across much of its range (67 FR 71240). The decline of bull trout is primarily due to habitat degradation and fragmentation, blockage of migratory corridors, poor water quality, past fisheries management practices, impoundments, dams, water diversions, and the introduction of nonnative species (63 FR 31647, June 10 1998; 64 FR 17112, April 8, 1999).

There is widespread agreement in the scientific literature that many factors related to human activities have impacted bull trout and their habitat and continue to do so. Among the many factors that contribute

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to degraded Primary Constituent Elements (PCEs) (see below for list of PCEs 1-9), those which appear to be particularly significant and have resulted in legacy of degraded habitat conditions are as follows:

Habitat fragmentation and isolation of local populations due to proliferation of dams and water diversions that have eliminated habitat, altered water flow and temperature regimes, and impeded migratory movements (Dunham and Rieman 1999; Rieman and McIntyre 1993).

Degradation of spawning and rearing habitat and upper watershed areas, particularly alteration in sedimentation rates and water temperature, resulting from forest and rangeland practices and intensive development of roads (Fraley and Shepard 1989; MBTSG1998).

The introduction and spread of nonnative fish species, particularly brook trout and lake trout, as a result of fish stocking and degraded habitat conditions, which compete with bull trout for limited resources and, in the case of brook trout, hybridize with bull trout (Leary et al. 1993; Rieman et al. 2006).

Degradation of foraging, migration, and overwintering (FMO) habitat resulting from reduced prey base, roads, agriculture, development, and dams.

Effects of Climate Change on Bull Trout Critical Habitat

Over a period of decades, climate change may directly threaten the integrity of the essential physical or biological features described in PCEs 1, 2, 3, 5, 7, 8, and 9. Protecting bull trout strongholds and cold water refugia from disturbance and ensuring connectivity among populations were important considerations in addressing this potential impact. Additionally, climate change may exacerbate habitat degradation impacts both physically (e.g., decreased base flows, increased water temperatures) and biologically (e.g., increased competition and non-native fishes).

Primary Constituent Elements (PCE) for Bull Trout Habitat (threatened)

Existing Condition

Within the designated critical habitat areas, the primary constituent elements (PCEs) 1-9 for bull trout are those habitat components that are essential for the primary biological needs of foraging, reproducing, rearing of young, dispersal genetic exchange, or sheltering. Based on our current knowledge of the life history, biology, and ecology of this species and the characteristics of the habitat necessary to sustain its essential life-history functions, the following PCEs are essential for the conservation of bull trout.

The USFWS final rule identified nine PCEs essential for the conservation of bull trout. A matrix of diagnostics/pathways and indicators was created by USFWS to rate each PCE indicator as Functioning Appropriately, Functioning at Risk, or Functioning at Unacceptable Risk (USFWS 1998). All nine PCEs are found within the Cedar Creek drainage.

PCE1. Springs, seeps, groundwater sources, and subsurface water connectivity (hyporheic flows) to contribute to water quality and quantity and provide thermal refugia.

Functioning Appropriately - Springs, seeps and other groundwater sources exist throughout the action area. There are numerous small seeps, springs, and areas of groundwater influence scattered throughout the Cedar Creek drainage and its tributaries. These areas provide upwelling and cold water refugia necessary for bull trout spawning and rearing.

The connectivity of Cedar Creek with its floodplain is intact throughout its length. Floodplains along Cedar Creek vary between narrow and wider open valley forms. Many of the existing riparian areas are functioning and are hydrologically linked.

Degradation of riparian vegetation exists along the banks of Cedar Creek. While riparian buffers, road closures and decommissions, and habitat improvements (removing the dam) have improved floodplain

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connectivity in the Cedar creek drainage, conditions that benefit cool water refugia and water connectivity have been slow to improve. The existing summer water temperatures in some reaches are above the tolerance level for bull trout fry and juveniles.

PCE 2. Migration habitats with minimal physical, biological, or water quality impediments between spawning, rearing, overwintering, and freshwater and marine foraging habitats, including but not limited to permanent, partial, intermittent, or seasonal barriers.

Functioning at Risk - Within the Cedar creek drainage, barriers to movement are primarily associated with road crossings containing undersized culverts. There are 6 partial barriers (one on Cedar Creek) and one total barrier (headwaters of Jim creek). There is a water quality barrier in the lower reaches that has been created, at least seasonally, by high temperatures. There are also several possible natural barriers (i.e., waterfalls) in Cedar and Jim Creeks. Brook trout also inhabit Cedar Creek and its tributaries which contribute to negative interactions causing biological impediments.

PCE 3. An abundant food base, including terrestrial organisms of riparian origin, aquatic macroinvertebrates, and forage fish.

Functioning at Risk - The Cedar creek drainage likely provides sufficient food base for juvenile, subadult, and adult bull trout. Numerous nonnative and native species in the Cedar creek drainage including macro invertebrates, sculpin, and brook trout provide a forage base for bull trout. However, the degraded condition of much of the Cedar creek drainage (moderate large woody debris and pool numbers) and the reduced abundance of native forest fish (sculpins, minnows) and cutthroat trout is probably the most serious persistent effect on bull trout food availability.

PCE 4. Complex river, stream, lake, reservoir, and marine shoreline aquatic environments and processes that establish and maintain these aquatic environments, with features such as large wood, side channels, pools, undercut banks and unembedded substrates, to provide a variety of depths, gradients, velocities, and structure.

Functioning at Risk - The riparian corridors within the Cedar creek drainage are highly impacted by activities occurring in the watershed, including but not limited to roads, forest practices, grazing, recreation, and rural development. Historic logging, historic dams, historic grazing and ongoing road density and locations, have reduced channel complexity, increased sediment, and constricted the floodplain. Restoration action such as cattle fencing, riparian harvest buffers, barrier removal projects, and road relocation and closure have improved conditions in Cedar Creek. Two of the four surveyed reaches are meeting large woody debris requirements and have adequate sources of woody debris available for both long- and short-term recruitment. Pool frequency exceeds in one of the four surveyed reaches, and pool frequency is lower but similar to values needed for proper functioning, but pools have inadequate cover and temperature. Two of four reaches are temperature deficient.

PCE 5. Water temperatures ranging from 2 to 15 °C (36 to 59 °F), with adequate thermal refugia available for temperatures that exceed the upper end of this range. Specific temperatures within this range will depend on bull trout life-history stage and form; geography; elevation; diurnal and seasonal variation; shading, such as that provided by riparian habitat; streamflow; and local groundwater influence.

Functioning at Unacceptable Risk - Water temperatures in Cedar Creek are influenced by several natural and manmade factors. In Cedar Creek, loss of riparian cover and wetland and floodplain connectivity and beaver activity likely have the greatest influence on temperatures.

The temperature standard for Cedar Creek is 12°C under Washington State water quality standards. Since this area is mostly spawning and rearing habitat, 9 °C would be the objective standard. The Colville National Forest has collected water temperatures in Cedar Creek since 1999. The 2015 temperature data

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illustrates the trend (Figure 3). Cedar Creek is on the WDOE 303(d) list of impaired streams for temperature and dissolved oxygen (Figure 4). Elevated temperatures are based upon a 7-day average maximum greater than 16 °C for core salmonid and 12 °C for native char.

Temperatures in mid-July through August are often beyond the tolerance level for bull trout (above 15°C/59°F). Water temperatures are apparently suitable for continued reproduction and survival of eastern brook trout and cutthroat trout in the watershed. Temperatures would also be suitable for bull trout spawning if they were present in the watershed. However, high temperatures between July and late September limit bull trout during their rearing life stage.

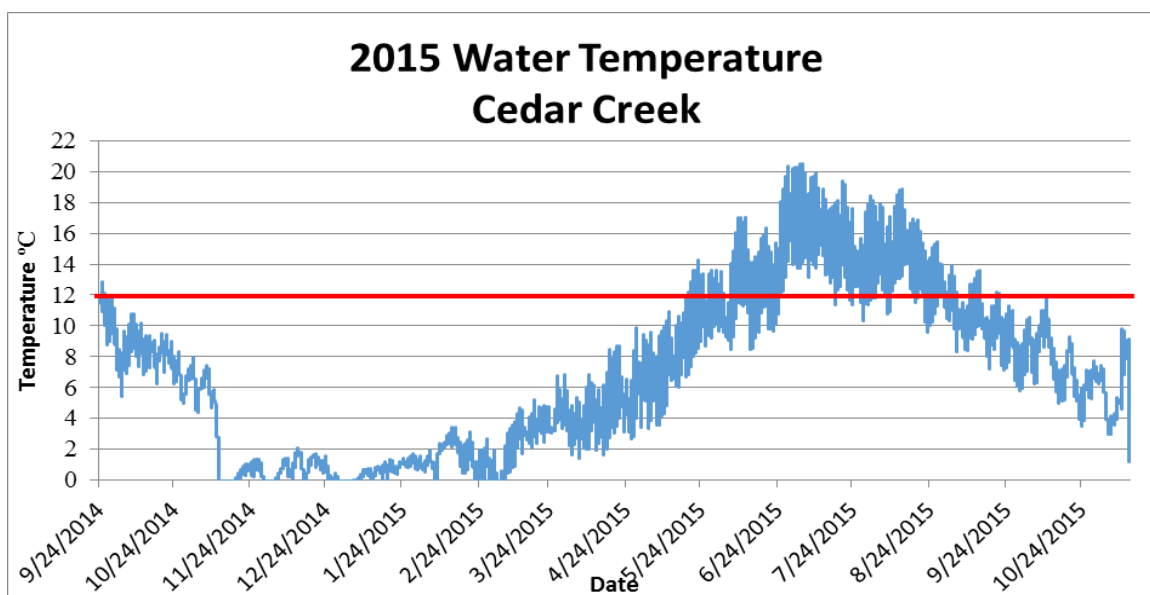


Figure 3. 2015 Water Temperatures in Cedar Creek

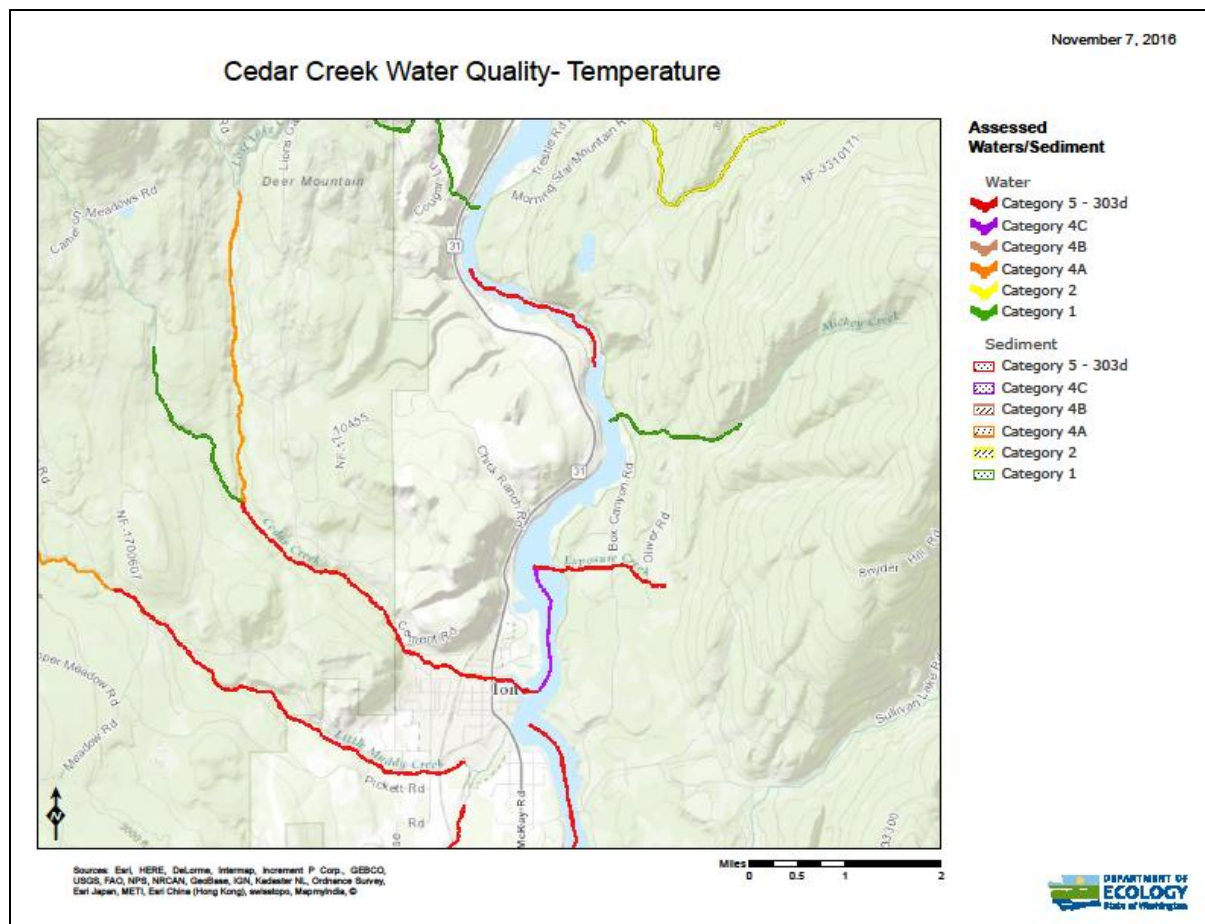


Figure 4. Cedar Creek Water Quality 303 (d) Category for temperature

The following categories pertain to Figure 4:

Category 1 - Meets tested standards for clean waters

Category 2 - Waters of concern

Category 3 - Insufficient data

Category 4 - Polluted waters that do not require a TMDL: waters that have pollution problems that are being solved in one of three ways:

- Category 4a - has a TMDL: water bodies that have an approved TMDL in place and are actively being implemented.
- Category 4b - has a pollution control program: water bodies that have a program in place that is expected to solve the pollution problems. While pollution control programs are not TMDLs, they must have many of the same elements and there must be some legal or financial guarantee that they will be implemented.
- Category 4c - is impaired by a non-pollutant: water bodies impaired by causes that cannot be addressed through a TMDL. These impairments include low water flow, stream channelization, and dams. These problems require complex solutions to help restore streams to more natural conditions.

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Category 5 - Polluted waters that require a TMDL or other Water Quality Index (WQI) project: the traditional list of impaired water bodies traditionally known as the 303(d) list. Starting with the 2008 Water Quality Assessment, Washington's 303(d) list of polluted waters were placed under Category 5 in the approved assessment. Placement in this category means that Ecology has data showing that the water quality standards have been violated for one or more pollutants, and there is no TMDL or pollution control plan. TMDLs or other approved WQI projects are required for the water bodies in this category.

Table 12. Seven-day average maximum stream temperatures for Cedar Creek.

Stream Name	2002	2003	2006	2007	2008	2009	2010	2015
Cedar Creek (Lower)	NA	NA	20.1	20.2	17.9	19.8	18.3	18.6
Cedar Creek (Upper)	17.3	17.7	NA	NA	NA	NA	NA	NA

Important stream temperatures associated with the table:

- Stream temperature unfavorable to salmonids:>21 °C (70 °F)
- Stream temperature for optimum growth of salmonids:<15 °C (59 °F)
- Washington State stream temperature standards for core salmonids:<16 °C (61 °F)
- Washington State stream temperature standards for native char: <12 °C (54 °F)

PCE 6. In spawning and rearing areas, substrate of sufficient amount, size, and composition to ensure success of egg and embryo overwinter survival, fry emergence, and young-of-the-year and juvenile survival. A minimal amount of fine sediment, generally ranging in size from silt to coarse sand, embedded in larger substrates, is characteristic of these conditions. The size and amounts of fine sediment suitable to bull trout will likely vary from system to system.

Functioning at Risk - Although no documented spawning currently occurs within Cedar Creek, suitable spawning gravels and rearing areas occur throughout the Cedar Creek drainage. Sedimentation from historic forest practices, road development, recreation, and grazing have increased embeddedness and fine materials and reduced areas of suitable substrates. Recent restoration activities, including culvert passage improvements and dam removal have begun to improve conditions in the watershed.

PCE 7. A natural hydrograph, including peak, high, low, and base flows within historic and seasonal ranges or, if flows are controlled, minimal flow departure from a natural hydrograph.

Functioning Appropriately - Base flow is regulated by snowmelt and natural conditions. No known impoundments are present within the Cedar creek drainage and stream hydrographs are functioning within normal range of variability as determined through stream surveys and personal observations.

PCE 8. Sufficient water quality and quantity such that normal reproduction, growth, and survival are not inhibited.

Functioning at Risk - In spawning areas, water quality and quantity are generally good with the exception of temperature (see PCE 5). In rearing areas, conditions are variable, with some degradation in both water quality (primarily due to increased sedimentation and temperature) and quantity. Cedar Creek is listed on the 303 (d) list for temperature and dissolved oxygen.

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PCE 9. Sufficiently low levels of occurrence of nonnative predatory (e.g., lake trout, walleye, northern pike, smallmouth bass); interbreeding (e.g., brook trout); or competing (e.g., brown trout) species that, if present, are adequately temporally and spatially isolated from bull trout.

Functioning at Unacceptable Risk - Several species of nonnative fish are present throughout the Cedar Creek drainage. These include brook trout and rainbow trout. All likely have negative effects to bull trout including competition, hybridization, and predation. Brook trout are widely distributed in Cedar Creek. While we know the negative interactions are occurring with nonnative fish species, we cannot quantify the magnitude of this effect.

PCE Summary

Integrating across PCEs, the overall existing condition of the Cedar Creek watershed is Functioning at Risk. The spawning and rearing areas are degraded for PCEs associated with water temperature, nonnative species, and habitat complexity.

The spring-fed system is functioning appropriately for hyporheic flows (PCE 1) and hydrograph (PCE 7), while habitat is degraded for PCEs 2, 3, 4, 6, and 8 and especially degraded for water temperature (PCE 5) and nonnative species (PCE 9).

Effects of the Proposed Action

The effects of the proposed action refer to the direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated or interdependent with the action, that will be added to the environmental baseline (50 CFR 402.02). Indirect effects are those that are caused by the proposed action and are later in time, but still are reasonably certain to occur. For cumulative effects analysis within project area subwatersheds and designated critical habitat basins, see the WCF tables included in this report.

Approximately 4.9 miles of critical habitat is located within the Cedar Creek drainage. No adverse effects to PCEs within the action are expected as a result of the project. The Cedar creek critical habitat represents less than 0.1 percent of the entire Clark Fork River CHU. No action in Cedar Creek will change the overall score of the CHU. Below lists each critical habitat PCE and discusses the effect to each.

PCE 1. Springs, seeps, groundwater sources, and subsurface water connectivity (hyporheic flows) to contribute to water quality and quantity and provide thermal refugia.

Functioning Appropriately - Harvest on 2,700 acres (~10%) in the Sweet Creek subwatershed is expected to move the forest stands back towards historic range of variability. The effect on the water yield would be similar to the current existing forest stand condition and the effect would be unmeasurable due to the small percentage of land being treated. Cumulative: Within the last 5 years, 312 acres have been treated within the subwatershed on private and State lands for a total 12% of the land proposed for treatment over a 10-year period. No foreseeable actions were identified in the subwatershed outside of the Forest Boundary per WADNR forest practices applications. Road density for the Sweet Creek subwatershed would be 0.9 mi/mi² for roads on NFS land with NFS jurisdiction, which is just under Forest Plan direction of less than 1 mi/mi² for focused restoration subwatersheds to be considered functioning properly.

PCE 2. Migration habitats with minimal physical, biological, or water quality impediments between spawning, rearing, overwintering, and freshwater and marine foraging habitats, including but not limited to permanent, partial, intermittent, or seasonal barriers.

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Functioning Appropriately - The Cedar Creek drainage be improved to functioning appropriately. All barrier culverts would be upgraded to aquatic organism passage structures. Once all barrier culverts have been replaced, habitat fragmentation will not be an issue.

PCE 3. An abundant food base, including terrestrial organisms of riparian origin, aquatic macroinvertebrates, and forage fish.

Functioning at Risk - Proposed actions are expected to have little effect on current food base conditions in Cedar Creek. Interspecific competition for food from non-native species is expected to persist in Cedar Creek.

PCE 4. Complex river, stream, lake, reservoir, and marine shoreline aquatic environments and processes that establish and maintain these aquatic environments, with features such as large wood, side channels, pools, undercut banks and unembedded substrates, to provide a variety of depths, gradients, velocities, and structure.

Functioning at Risk - Aquatic habitat would improve in the Cedar Creek drainage. In areas with riparian thinning, the goal is to increase the growth rate of trees by reducing competition. This should move towards restoring the large wood recruitment rates to riparian areas in the watershed over the long term.

Overall large wood in streams will increase especially in reaches where the wood is low which will improve channel shape and function. Large woody debris improves the sorting of the substrate. The large woody debris should improve connection of the floodplain where floods will be able to leave the channel and reduce scour on stream banks and deposit sediment on the floodplain. Some sedimentation is expected from road reconstruction activities.

Removal of riparian roads, large woody debris placement, and following best management processes, the sediment should not be noticeably measurable beyond current levels. Less than 25% of the stream channels would have width-to-depth ratios above natural levels. Floodplain connection would be improved.

While road decommissioning and other projects listed above would improve conditions, including the reduction of road density from 5.0 mi/mi² to 3.5 mi/mi², Cedar Creek would remain Functioning at Risk due to 47% of open road miles remaining within 300 feet of streams post-project as per WCF metrics.

PCE 5. Water temperatures ranging from 2 to 15 °C (36 to 59 °F), with adequate thermal refugia available for temperatures that exceed the upper end of this range. Specific temperatures within this range will depend on bull trout life-history stage and form; geography; elevation; diurnal and seasonal variation; shading, such as that provided by riparian habitat; streamflow; and local groundwater influence.

Functioning at Unacceptable Risk - Existing temperature data indicates that within the Cedar Creek drainage temperatures are elevated and exceed the upper end suitable for bull trout during summer months. Silvicultural prescriptions adjacent to streams would be designed to maintain or improve shading effect on streams to maintain or improve water temperature conditions within the streams. Cedar Creek has been identified for wood enhancement which may have a beneficial effect on water temperature, however these measures are unlikely to move water temperatures to viable levels for bull trout life history.

PCE 6. In spawning and rearing areas, substrate of sufficient amount, size, and composition to ensure success of egg and embryo overwinter survival, fry emergence, and young-of-the-year and juvenile survival. A minimal amount of fine sediment, generally ranging in size from silt to coarse sand, embedded in larger substrates, is characteristic of these conditions. The size and amounts of fine sediment suitable to bull trout will likely vary from system to system.

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Functioning at Risk - Reaches 2, 4, and 6 of Cedar Creek have wood placement which will improve channel shape and function. Large woody debris improves the sorting of the substrate. The large woody debris should improve connection of the floodplain where floods would be able to leave the channel and reduce scour on stream banks and deposit sediment on the floodplain. Some sedimentation is expected from road reconstruction activities. However, removal of riparian roads, large woody debris placement and following best management processes, the sediment should not be noticeably measurable beyond current levels. Less than 25% of the stream channels would have width-to-depth ratios above natural levels. Floodplain connection will be improved.

PCE 7. A natural hydrograph, including peak, high, low, and base flows within historic and seasonal ranges or, if flows are controlled, minimal flow departure from a natural hydrograph.

Functioning Appropriately - Harvest on 2,700 acres (~10%) in the Sweet Creek subwatershed west of the Pend Oreille River is expected to move the forest stands back towards historic range of variability. The effect on the water yield would be similar to the current existing forest stand condition and the effect would be unmeasurable due to the small percentage of land being treated.

PCE 8. Sufficient water quality and quantity such that normal reproduction, growth, and survival are not inhibited.

Functioning at Risk - While proposed actions will maintain or improve water quality to a small degree through the reduction of sediment via road decommissioning, large wood placement, and application of BMPs, it is unlikely that conditions would improve to the point that streams would be removed from the 303 (d) list for temperature. Nor is it likely that conditions would improve to a level allowing for normal reproduction, growth, or survival of Bull Trout.

PCE 9. Sufficiently low levels of occurrence of nonnative predatory (e.g., lake trout, walleye, northern pike, smallmouth bass); interbreeding (e.g., brook trout); or competing (e.g., brown trout) species that, if present, are adequately temporally and spatially isolated from bull trout.

Functioning at Unacceptable Risk - Unless the brook trout population is removed, brook trout would remain the system. Unless Brook trout populations are removed, this species will persist. Non-native species and associated risks to native species (predation, hybridization, interspecific competition for resources) will continue to inhibit Bull Trout re-population of Cedar Creek.

PCE Summary: Cedar Creek

Based on the PCE and WCF effects analysis for this project, the proposed actions **May Affect, but are Not Likely to Adversely Affect Bull Trout** and **May Affect, but are Not Likely to Adversely Affect designated Bull Trout Critical Habitat**.

The Cedar creek drainage includes approximately 4.9 miles of designated critical habitat within the Clark Fork River CHU. The Cedar creek drainage represents less than 0.1 percent of total critical habitat in the CHU. While some effects on bull trout critical habitat are expected at the local level, no adverse effects are expected in the long term. The majority of the effects on PCEs would come from improvements to habitat and barrier removal.

There may be some short-term negative impacts in the Cedar Creek drainage from road construction activities, but there are long term benefits from large woody debris placement, riparian thinning, and barrier removal. The proposed action would improve baseline conditions in the drainage. The project should improve conditions over the long-term.

There may be some short-term negative impacts in the Cedar Creek drainage from road construction and decommissioning activities, but there are long term benefits from large woody debris placement, riparian

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thinning, and barrier removal. The proposed action will improve baseline conditions in the drainage at specific locations over the long-term, though not to the extent to improve PCE ratings for critical habitat in the drainage as a whole.

Table 13. Cedar Creek PCE Summary: Existing Condition and Effects of Proposed Action

PCE	Existing Condition	Proposed Action Effects
PCE 1. Springs, seeps, groundwater sources, and subsurface water connectivity (hyporheic flows) to contribute to water quality and quantity and provide thermal refugia.	Functioning Appropriately	Functioning Appropriately
PCE 2. Migration habitats with minimal physical, biological, or water quality impediments between spawning, rearing, overwintering, and freshwater and marine foraging habitats, including but not limited to permanent, partial, intermittent, or seasonal barriers.	Functioning at Risk	Functioning Appropriately
PCE 3. An abundant food base, including terrestrial organisms of riparian origin, aquatic macroinvertebrates, and forage fish.	Functioning at Risk	Functioning at Risk
PCE 4. Complex river, stream, lake, reservoir, and marine shoreline aquatic environments and processes that establish and maintain these aquatic environments, with features such as large wood, side channels, pools, undercut banks and unembedded substrates, to provide a variety of depths, gradients, velocities, and structure.	Functioning at Risk	Functioning at Risk
PCE 5. Water temperatures ranging from 2 to 15 °C (36 to 59 °F), with adequate thermal refugia available for temperatures that exceed the upper end of this range.	Functioning at Unacceptable Risk	Functioning at Unacceptable Risk
PCE 6. In spawning and rearing areas, substrate of sufficient amount, size, and composition to ensure success of egg and embryo overwinter survival, fry emergence, and young-of-the-year and juvenile survival. A minimal amount of fine sediment, generally ranging in size from silt to coarse sand, embedded in larger substrates, is characteristic of these conditions. The size and amounts of fine sediment suitable to bull trout will likely vary from system to system.	Functioning at Risk	Functioning at Risk
PCE 7. A natural hydrograph, including peak, high, low, and base flows within historic and seasonal ranges or, if flows are controlled, minimal flow departure from a natural hydrograph.	Functioning Appropriately	Functioning Appropriately
PCE 8. Sufficient water quality and quantity such that normal reproduction, growth, and survival are not inhibited.	Functioning at Risk	Functioning at Risk
PCE 9. Sufficiently low levels of occurrence of nonnative predatory (e.g., lake trout, walleye, northern pike, smallmouth bass); interbreeding (e.g., brook trout); or competing (e.g., brown trout) species that, if present, are adequately temporally and spatially isolated from bull trout.	Functioning at Unacceptable Risk	Functioning at Unacceptable Risk

7.0 References

- Cavender, T.M. 1978. Taxonomy and distribution of bull trout, *Salvelinus confluentus* (Suckley), from the American Northwest. California Fish and Game 64: 139-174.
- Dunham, J.B., Rieman, B.E., 1999, Metapopulation structure of bull trout - Influences of physical, biotic, and geometrical landscape characteristics: Ecological Applications, v. 9, no. 2, p. 642-655
- Fraley, J.J., and B.B. Shepard. 1989. Life history, ecology and population status of migratory bull trout (*Salvelinus confluentus*) in the Flathead Lake and river system, Montana. Northwest Science 63(4):133-143.
- Grant, Gordon E., S.L. Lewis, F.J. Swanson, J.H. Cissel, and J.J. McDonnell. 2008. Effects of forest practices on peak flows and consequent channel response: a state-of-science report for western Oregon and Washington. Gen. Tech. Rep. PNW-GTR-760. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. p.76.
- Jeronimo, Sean and Churchill, Derek. 2018. Trail Project Area Landscape Evaluation. Washington Department of Natural Resources, Olympia, WA.
- Leary, R.F., F.W. Allendorf, & S.H. Forbes. 1993. Conservation genetics of bull trout in the Columbia and Klamath River Drainages. Conservation Biology 7:856-865.
- MacDonald, L.H., A.W. Smart, and R.C. Wissmar. 1991. Monitoring guidelines to evaluate effects of forestry activities on streams in the Pacific Northwest and Alaska. U.S. Environmental Protection Agency, Region 10. University of Washington, EPA 90/6-91-001, Seattle, WA, June 1994. 166 pp.
- Montana Bull Trout Scientific Group (MBTSG). 1998. The relationship between land management activities and habitat requirements of bull trout. Report prepared for the Montana Bull Trout Restoration Team, Helena, Montana.
- Shepard, B.B., S.A. Leathe, T.M. Weaver, and M.D. Enk. 1984. Monitoring levels of fine sediment within tributaries to Flathead Lake, and impacts of fine sediment on Bull trout recruitment. In Proceedings of the Wild Trout III Symposium, September 24 - 25, 1984, Mammoth Hot Springs, Yellowstone National Park, Wyoming. 11 pp.
- USDA Forest Service. 2019. Colville National Forest Land Management Plan and Final Environmental Impact Statement. Pacific Northwest Region, Portland, OR.
- USDA Forest Service. 2012. National Best Management Practices for Water Quality Management on National Forest System Lands. FS-990a. Volume 1: National Core BMP Technical Guide. Washington DC: U.S. Department of Agriculture, Forest Service. 165 pp.
- USDA Forest Service 2011. Watershed Condition Classification Technical Guide. FS-978
- USDA Forest Service. Level II Stream Habitat Surveys. Forest Service, Colville National Forest. Available at Newport Ranger District, Newport Washington.
- USDA Forest Service. Hydrologic Road Surveys. Forest Service, Colville National Forest. Available at Newport Ranger District, Newport Washington.
- USFWS (U.S. Fish and Wildlife Service). 2013. Programmatic Biological opinion for Aquatic Restoration Activities in the States of Oregon, Washington and portions of California, Idaho and Nevada (ARBO II). FWS reference: 01EOFW00-2013-F-0090. Portland, Oregon.

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WADoE. 2006. Colville national forest temperature and bacteria total maximum daily load - water quality implementation plan. 80 pp.

WADoE. 2018. Water Quality Assessment 305(b) report and 303(d) list.
<http://www.ecy.wa.gov/programs/wq/303d/2008/index.html>

WDFW. 2017. Memorandum of understanding, Washington Department of Fish and Wildlife AND USDA Forest Service Pacific NW Region. 8 pp.